Cultivating Urbanism:
Transforming the Existing City through Agrarian Interventions

Takao Ugai
December 2012

Submitted towards the fulfillment of the requirements for the Doctor of Architecture Degree.

School of Architecture
University of Hawai‘i

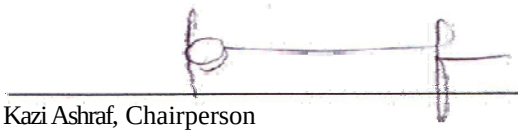
Doctorate Project Committee
Kazi Ashraf, Chairperson
Andrew Kaufman
Makena Coffman

Cultivating Urbanism:
Transforming the Existing City through Agrarian Interventions

Takao Ugai
December 2012

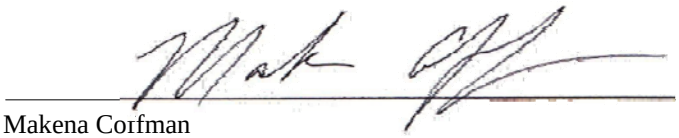
We certify that we have read this Doctorate Project and that, in our opinion, it is satisfactory in scope and quality in fulfillment as a Doctorate Project for the degree of Doctor of Architecture in the School of Architecture, University of Hawai'i at Mānoa.

Doctorate Project Committee



Kazi Ashraf, Chairperson

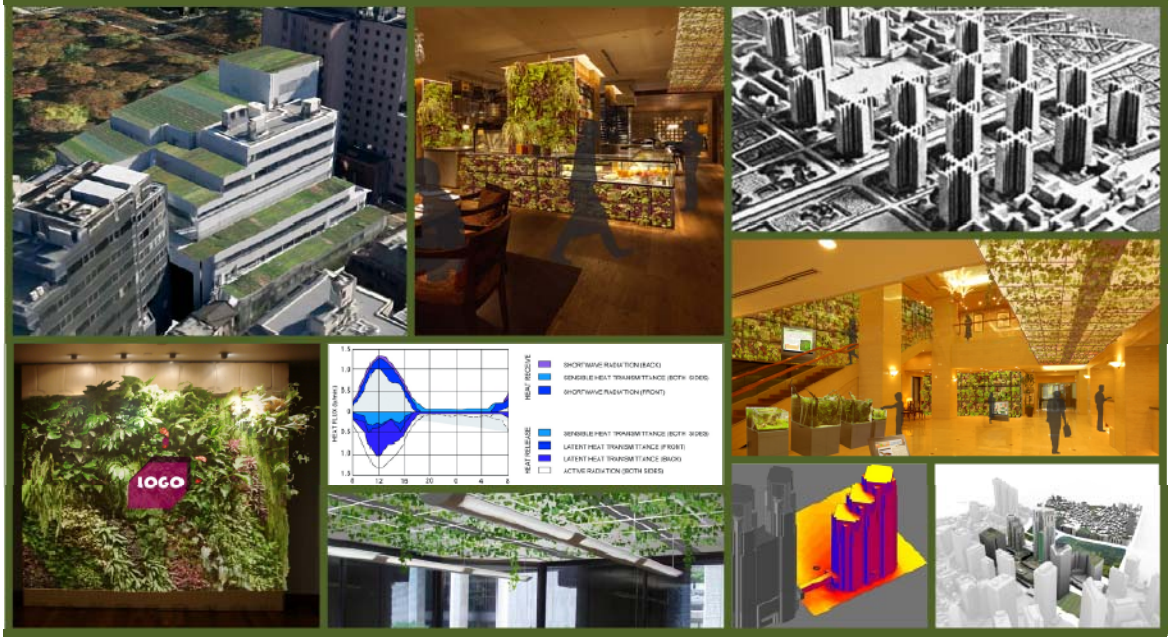
Andrew Kaufman



Makena Corfman

Cultivating Urbanism:

Transforming the Existing City through Agrarian Interventions



Takao Ugai

Acknowledgement

I would like to greatly and sincerely thank Professor Kazi Ashraf for his guidance, understanding, patience, and most importantly, his friendship throughout my graduate studies at University of Hawai'i at Mānoa. His mentorship played a paramount role in providing me well rounded and meaningful experience, which helped to establish my long-term career goals. He encouraged me to not only grow as an architect but also as an independent thinker. I am not sure how many graduate students are fortunate enough to be given the same level of opportunity to develop their own individuality and self-sufficiency while trusted with much freedom and independence. For everything you have done for me, Kazi, I thank you. One day, I would like to become an honorable professor like you.

I would also like to thank two other committee members, Dr. Makena Coffman and Dr. Andrew Kaufman, for their input, valuable discussions, accessibility and tireless support.

I would like to thank Honolulu Blueprint and Supplies, Roy Kelley and Allen Johnson for providing me with generous travel financial support for the research. I would also like to thank Mr. Roy Yamamoto and his firm, Roy K. Yamamoto, Architect, AIA, Inc. for the financial support throughout my doctorate studies. I could not have been where I am today without his complete support and patience.

Finally, and most importantly, I would like to thank my wife, Mio. Without her support and understanding, it would have been impossible for me to finish this work. I was able to stay healthy throughout my graduate studies with minimum sleeping hours because of her wholesome homemade meals. Her obsession for food considerably influenced my dissertation as well. Moreover, I do not know how to thank her for proof reading my entire dissertation within her busy schedule. I also thank my parents, Masamichi and Keiko, for giving birth to me and raising me. Lastly, I thank Mio's parents, Takashi and Yoko. They provided me with never ending encouragement and support.

Contents

List of Tables

List of Figures

Abstract

The aim of this investigation is to develop a new urban scheme for Cultivating Urbanism. The research will focus on adapting agricultural practices into the existing urban fabric and argue for the reason to do so. The objective is to develop existing cities into pedestrian friendly, mix-use and high-density, which are filled with agriculture.

The argument for Cultivating Urbanism is based on both New Urbanism and Agricultural Urbanism. People around the globe are showing remarkable interests in agriculture, food securities, community deficiency, nature-deficit disorder, carbon footprints, heat island effect, stormwater management and peak oil. I believe it is timely to pursue new practices of agriculture in urban areas and condition.

The research studies the history of the relationship between the urban system and agriculture practices. Until recently, agriculture and the city were generally regarded as two distinctively separate classes, even antithetical. By analyzing and extracting the advantages of both New Urbanism and Agricultural Urbanism, this study propose new urban typologies. It envisions a new city that transcends and mediates the history and opportunities between the city and agriculture practices. The paradigm of ecology, lifestyle, food products, and physical and psychological benefits are investigated.

Shinjuku, Tokyo is chosen to investigate and install the principles of Cultivating Urbanism. The research of the site covers broadly in food habits, food safety, food independence and spacial analysis. (The general demographic, landuse and climate analysis are introduced in Appendix A.) Various urban agriculture methodologies were adapted to certain buildings as prototypes; they include low and high-rise residences, hotels, public parks, schools, restaurants, commercial and public high-rise buildings and underground walkways.

1. Introduction

1.1 Prelude

The majority of recent challenges facing people; such as global warming, peak oil, carbon footprints, heat island effect, food securities, and growing population, could be mitigated by adapting agricultural practices into cities; however, urban agriculture has potential for reforming social defect as well.

Typically, when people discuss urban agriculture, they envision “developing” countries. In developing countries, the capacity of governments to manage the urban growth is threatened, and in many countries, it is already on the decline. The creation of "sustainable cities" and the identification of ways to provide food are a challenge to many city authorities around the world. Food security issues are also a challenge in developed countries. Any types of catastrophes or conflicts between major trading countries could threaten a nutritious balance. Moreover, social issues such as community deficiency, high-stress levels and nature-deficit disorder are growing problems.

The most striking feature of urban agriculture, which distinguishes it from rural agriculture, is that it is integrated into the urban economic, community and ecological system: urban agriculture is embedded in –and interacting with- the urban ecosystem. Such linkage includes the use of urban residents as volunteers or part time laborers, use of typical urban resources (i.e. organic waste as compost and urban wastewater for irrigation), direct links to urban consumers, direct impacts on urban ecology, being part of the urban food system, competing for land with other urban functions, being influenced by urban policies and plans, etc. Urban agriculture is not a relict of the past that will fade away nor brought to the city by rural immigrants that will loose their rural habits over time. It is a vital part of the green and healthy urban system.

1.2 New Prospects for a Synthesis of the City and Agriculture

In the early 1980s, New Urbanism arose in the United States, which was strongly influenced by urban design standards prominent before the rise of the automobile, and it encompasses principles such as traditional neighborhood design (TND) and transit-oriented development (TOD).[1] The Congress for the New Urbanism was founded in 1993 as the organizing body for New Urbanism. Its foundational text is the Charter of the New Urbanism:

> "We advocate the restructuring of public policy and development practices to support the following principles: neighborhoods should be diverse in use and population; communities should be designed for the pedestrian and transit as well as the car; cities and towns should be shaped by physically defined and universally accessible public spaces and community institutions; urban places should be framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice."[2]

As expressed in the statement above, urban design has been concentrating mainly on various transportation and public spaces. Moreover, landscape design has received much attention from some of the architects in the recent years. Charles Waldheim, Nina-Marie Lister, James Corner, Chris Reed, and Dean Almy are practitioners and theorists, who have been introducing the alteration of urbanism called Landscape Urbanism. They argue that landscape architecture is more capable of organizing the urban matrix and enhancing the urban experience, than architecture. Charles Waldheim has asserted "Landscape Urbanism was specifically meant to provide an intellectual and practical alternative to the hegemony of the New Urbanism."[3] Most of the important projects related to this theory have yet to be built, like un-built design by Rem Koolhaas; however, they are under the development of the theory and just started to garner attention.

---

1. Doug Kelbaugh, Repairing the American Metropolis (Seattle: University of Washington Press, 2002), 161.
2. Michael Leccese, Kathleen McCormick, and Congress for the New Urbanism., Charter of the New Urbanism (New York: McGraw Hill, 2000).
3. Michael Mehaffy, "The Landscape Urbanism: Sprawl in a Pretty Green Dress?," Planetizen: Urban Planning, Design and Development Network, http://www.planetizen.com/node/46262.

Until recently, agriculture and city were generally regarded as two distinctively separate categories. For centuries, and across many disciplines, the country and the city have been distinct in opposition to one another. Conventional agriculture methodologies require large amount of open land, and those were owned and managed by fulltime farmers in rural areas. People in the city consume those crops and provide services for the farmers. They were complementing each other in a beneficial way. However, various designers, urban planners, theorists and researchers have recently acknowledged the potential of urban agriculture. Andres Duany, one of the founders of the New Urbanism movement, led a charrette in 2008 that introduced the possibilities of integrating agricultural activity back into a built urban environment. Duany and other urbanists worked with Michael Ableman, an organic farmer and author, to design a city of 538-acre in Canada that could provide almost 2,000 housing units while integrating agricultural methodologies. Called "Agricultural Urbanism," the new formation weaves various food-related activities, such as small farms, shared gardens, farmers' markets, and agricultural processing, into a walkable mixed-use traditional small town design[4]. This project is unique, because it is integrating agriculture and urbanism at all levels. It could become an influential model, counteracting the interrelated problems of tightening world food supplies, reduced carbon footprint, better public health and the related benefits of pre-industrial farming techniques, including enhanced biodiversity and ecological sustainability. A small number of agricultural and social reformers have argued for years that more of the United States' food should be produced close to where the consumers live; Agricultural Urbanism may be one way to accomplish that.

4. Kevin Buchanan, "Agricultural Urbanism –Integrating Farming with the Built Environment," http://fortworthology.com/2008/07/15/agricultural-urbanism-integrating-farming-with-the-built-environment/.

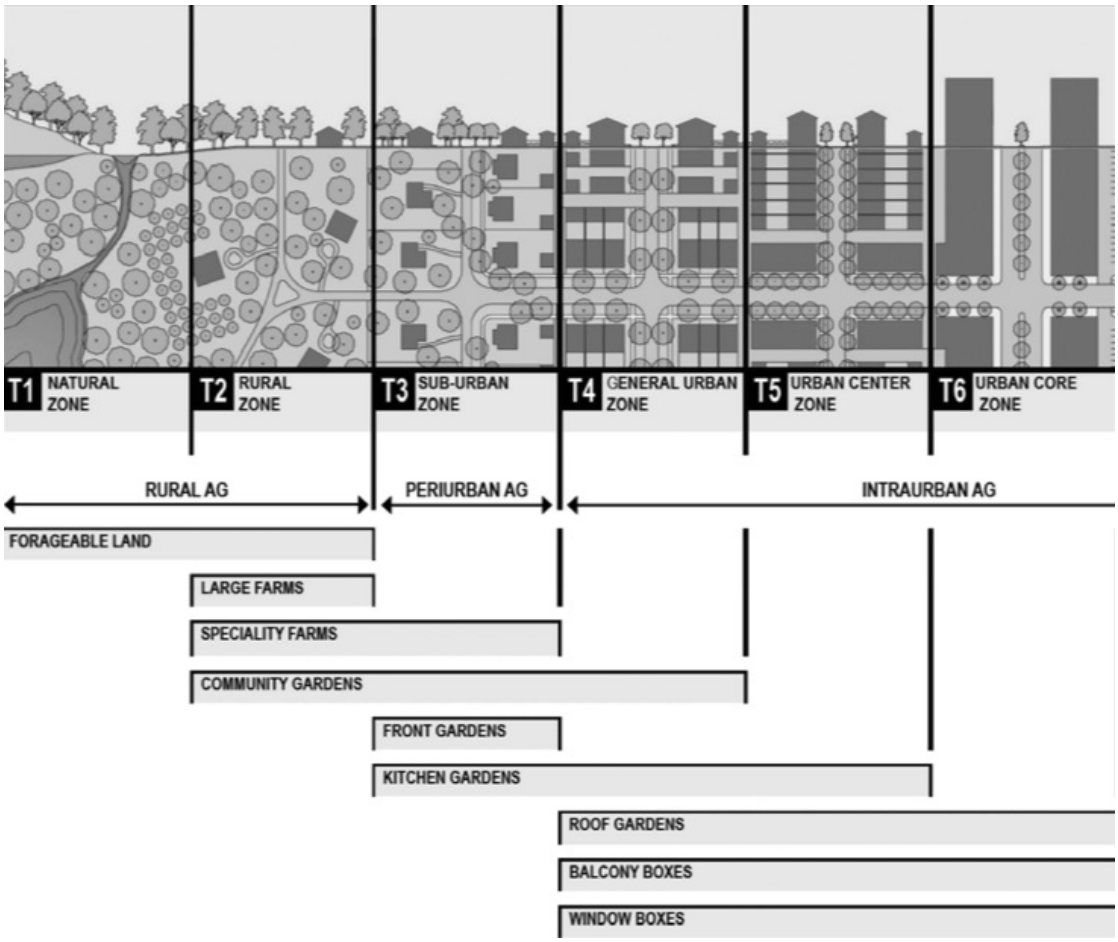


Figure 1 A Transect diagram with added details of where the various kinds of agricultural urbanism fit into the urban fabric (Source: Buchanan, Kevin. "Agricultural Urbanism – Integrating Farming with the Built Environment." *Fortworthology* (2008))

On the other hand, in the example by Kevin Buchanan, current agrarian movement is based on low density ecological city (Figure 1). Most of the theoretical projects are located at the brownfield or greenfield site to construct entirely new urban formation. By accepting the urban sprawl, it is not only making a rebuttal statement to the New Urbanism but also regressing towards Le Corbusier's highly influential book, *the Radiant City*:

Le Corbusier wrote:

> "The cities will be part of the country; I shall live 30 miles from my office in one direction, under a pine tree; my secretary will live 30 miles away from it too, in the other direction, under another pine tree. We shall both have our own car. We shall use up tires, wear out road surfaces and gears, consume oil and gasoline. All of which will necessitate a great deal of work … enough for all."[5]

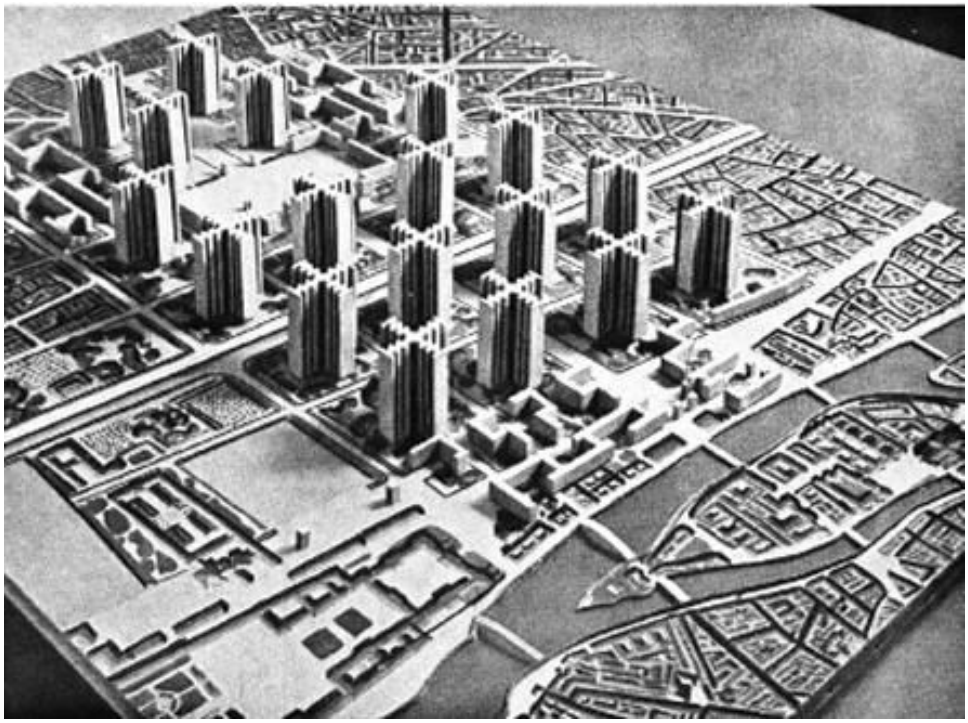


Figure 2 The Radiant City (Source: Le, Corbusier. *The radiant city; elements of a doctrine of urbanism to be used as the basis of our machine-age civilization.* New York, Orion Press.)

It has been widely discussed that urban sprawl is not a healthy growth. Some might […] see it as a way of bringing more freedom, mobility, and prosperity to people.[6] They might also see this as reconciling city and country living – bringing the countryside

5. Corbusier Le, *The Radiant City; Elements of a Doctrine of Urbanism to Be Used as the Basis of Our Machine-Age Civilization* (New York,: Orion Press, 1967).

6. Robert Bruegmann, *Sprawl : A Compact History* (Chicago: University of Chicago Press, 2005), 43-46.

to an urban middle class.[7] But urban sprawl has numerous downsides. Even at fairly low densities, sprawl tends not to pay for itself economically and consumes land at a frightening rate. Sprawling development patterns are fragmented habitat, endangering sensitive land and water bodies, destroying precious farmlands, and increasing the burden on municipal infrastructure.[8] Segregated land use accessed by high-speed roadways that necessitate the use of cars has been the predominant development pattern over the past 50 years. In the United States, transportation accounts for roughly one-third of greenhouse gas emissions, and the large portion of which can be attributed to personal automobile use.[9] Burning fossil fuels for transportation increases air pollution and related respiratory diseases. Car oriented urban matrix tends to be unsupportive of traditional mixed-use neighborhood centers and are unsuited for pedestrians. Sprawling development patterns endanger sensitive land and water bodies, destroy precious farmland, fragment habitat, and increase the burden on municipal infrastructure.[10]

In contrast, by placing residences and jobs in close proximity to each other, considerate urban planning and development can limit automobile trips and the associated greenhouse gas emissions. Mixed-use high-density development and pedestrian friendly streets encourage walking, bicycling, and public transportation for daily commuting.

Both Agriculture Urbanism and New Urbanism are antagonistic to each other. However, both movements have advantages and drawbacks. Agriculture Urbanism could supply our food in close proximity but the same time, it would lead us to urban sprawl. New Urbanism would encourage keeping the compact city to avoid the urban sprawl, but it will lead the city to become a uncomfortable concrete jungle and increase food's carbon footprint. They can be merged together, take advantage of both concepts, and develop a

---

7. Gregory D. Squires, *Urban Sprawl : Causes, Consequences, & Policy Responses* (Washington, D.C.: Urban Institute Press, 2002), 159.

8. Natural Congress for the New Urbanism and the U.S. Green Building Council Resources Defense Council, *Leed 2009 for Neighborhood Development* (Washington, DC: U.S. Green Building Council, Inc., 2010), xi.

9. "Greenhouse Gases, Climate Change, and Energy," *Energy Information Administration* (May, 2008).

10. Congress for the New Urbanism and Resources Defense Council, *Leed 2009 for Neighborhood Development*.

new urbanism movement, which I would like to refer to as Cultivating Urbanism. What we must avoid is to develop entirely new cities in already developed countries. The populations in most of these countries are either shrinking or remaining the same,[11] and there is no need for creating new cities; however, it is more realistic and sustainable to consider how people can develop the existing cities and make them pedestrian friendly, mix-use, high-density, and filled with agriculture.

There are many things in the world that did not become popular no matter how truly beneficial they were with very minimal deficit. I believe it was because of the people's interest. People's interest has great influence especially when the content is in macro scale.

In recent times, many people living in the urban areas around the world are interested in agriculture. There is curious example that among thousands of games played over social network, farming games have been the most popular and embraced in many countries. Not only the virtual games, but real farming has also become very popular in urban areas. These facts are showing that there is a significant interests and needs for urban agriculture today.

Figure 3 Facebook's Farmville
(Screen captured by Takao Ugai)

FarmVille is a farming social network game developed by Zynga. It is available on Facebook, a social networking website, and as an application on Apple iPhones. The game allows members of Facebook to manage a virtual farm by plowing land, planting, growing and harvesting virtual crops, harvesting trees and bushes, and by raising livestock (Figure 3). FarmVille has grown to be the social

11. Population Reference Bureau, "World Population Data Sheet," (Population Reference Bureau, 2008).

network's most popular application, with over 62 million active users and over 24.6 million Facebook application fans as of September 2010.[12]

Mainland China's 2nd largest social game maker Rekoo launched a flash-based social game on Japan's largest social network service, Mixi in August, 2009. It is called Sunshine Ranch (サンシャイン牧場), which earned more than two million users in less than two months since the launch (Figure 4).[13] Since the launch of the game, it remains as the most popular game in Mixi applications and currently played by 5.6 million Mixi members on the PC, regular cell phone, and application on Apple iPhone and Google Android.

Figure 4 Sunshine Ranch (Screen captured by Takao Ugai)

Thirdly, Happy Farm (开心农场) is a multiplayer online game based on farm management, played predominantly by users in Mainland China and Taiwan, and is the most popular social game in the region (Figure 5). There are 23 million daily active users, logging on to the game at least every 24 hours.[14] Approximately 15 million urban

12. Justin Smith, "Farmville," Web Media Brands Inc., http://www.appdata.com/apps/facebook/102452128776-farmville.

13. Asiajin, "Sunshine Ranch: More Than 2m Japanese Users Join China-Made Flash Game in 2 Months," Asiajin - the next generation interenet trends in Japan and Asia, http://asiajin.com/blog/2009/10/26/sunshine-ranch-more-than-2m-japanese-users-join-china-made-flash-game-in-2-months/.

14. "China's Social Gaming Landscape: What's Coming Next," ReadWriteWeb, http://www.readwriteweb.com/archives/china_social_gaming_landscape_whats_coming_next.php.

white-collar workers are estimated to spend more than five hours a day on Happy Farm.[15] Because of its popularity, the game's host, Tencent QQ, has capped the number of new players per day at 2 million.[16]

Figure 5 Happy Farming (Screen captured by Takao Ugai)

There are a number of other virtual social farming games available such as Xiaone, Kaixin001, 51.com, QZone, Everybody's Farm, Farm Town, Farmandia and many more. Surprisingly, most of them are ranked as the most popular social games among many others. From these facts, at least in the virtual worlds of social games, it is obvious that a considerable number of people feel farming is interesting and engaging and even find joy in it.

Simultaneously, people living in the urban areas are becoming more interested in actual farming. Recently, a farm land service called "happy farm in reality" opened in the suburbs of Shanghai, where white-collar workers from around that region can experience a real farmer's life.[17] According to an interview on Chinese website, "People's

15. Elliott Ng, "China's Growing Addiction: Online Farming Games," VentureBeat, http://venturebeat.com/2009/10/29/china-qq-farm-happy-farm-games/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+Venturebeat+%28VentureBeat%29.

16. Victoria Ho, "China Wants Multiplayer, Micropayments," ZDNET, http://www.zdnetasia.com/china-wants-multiplayer-micropayments-62061926.htm.

17. "Weekday White-Collars Turn Farmers at Weekend," People's Daily Online, http://english.people.com.cn/90001/90782/90872/6711319.html.

Daily Online", a new style of spending the weekends is becoming popular. Mr. Liu, a white-collar worker, who lives in the Pudong district with his family, rented a piece of farmland in the suburb for a 3, 000 yuan (about US$460) membership fee. On weekends, the whole family drives out to their own farm for fun; watering, weeding, fertilizing and worming, which bring them unique experience and fun. And during the harvest season, they usually take the harvest back to share and enjoy with their friends and neighbors. Mr. Liu said they take part in the program on one hand to bring the family and his children a special experience, and on the other, so they can eat the products without any concerns about pollution. He also said since they joined the membership more than a month ago, they have gone to their farm every weekend to experience the special "happiness."

Similarly, in Japan, various media played up that many people are willing to work in agriculture. With the help of the national campaign, "Food Action Nippon" (described further in Chapter 2), young girls in Tokyo played a central role in increasing the Japanese food independence. This movement caused a considerable impact over people that they have generated a fashionable new word, "Nou-gal" (農ギャル). "Nou" is abbreviation of "Nougyo" which means agriculture, and gal is as in English, young girl. Moreover, Nou-gal has made their brand rice, which is called "Shibuya-mai" (シブヤ米) (Figure 6). "Shibuya" is the name of a major train station and a fashionable town in Tokyo, where young people like to gather.

Figure 6 Picture of "Nou-gal" (left) and "Shibuya-mai" (right)

There are many other examples. The U.S. Sustainability and Public Transportation in Philadelphia has established Walnut Hill Community Farm on its property in 2012.[18] Their goal is having fresh food available within a 10-minute walk of 75% of Philadelphia's population. The farm provides multiple benefits to the community, including access to fresh food, maintenance of green space, pride of place resulting in less graffiti and vandalism, educational and employment opportunities for youth, and overall capacity-building within the neighborhood.[19]

Figure 7 Walnut Hill Community Farm in Philadelphia (photo by Philadelphia LISC)

Common Good City Farm is another example of community farming that is popular in Washington D.C. It is an urban farm and education center growing food with and for low-income local residents. The system provides educational opportunities for the participants who contribute to increase food security, improve health, and contribute to environmental sustainability.[20]

---

18. Catherine Calvert, "Transit + Food = Sustainability in Philadelphia," VIA Architecture, http://via-architecture.blogspot.com/2012/09/transit-food-sustainability-in.html.

19. Ibid.

20. Maureen Moodie, "The Mid-Atlantic Red Fruit Festival," in *DC's Field to Fork* (Washington D.C.: DC's Field to Fork Network, 2010).

There are nearly 500 community farms in a world of asphalt and brick, New York.[21] They are spaces where city residents can come together to build and enjoy green space, grow food, learn, meet, and spend time together, and have been enormously valuable ecologically, socially, and economically for decades. Community gardening is gaining popularity, and NYC is experiencing an increase in urban agriculture and sustainability initiatives such as rainwater harvesting and composting.[22]

However, even these famous community farms have some issues with administration. Ms. McPherson who holds the keys to three community gardens in Bedford-Stuyvesant mentioned that "In an ideal situation, we would have gardens with everyone in the community participating. […] But in fact, a few die-hard people end up carrying the flag."[23] Community farming must be carried out through careful deliberation as to how it should be managed, otherwise imbalance of work load or responsibility may become an issue and the system can fail as result. In order to develop a healthy community with rich farm land, I researched academic institutes of agriculture in Tokyo.

There are a total of 138 universities, 19 architectural departments, 17 pharmacy departments, and 48 biology departments in Tokyo alone.[24] Surprisingly, there are only 3 universities that have agricultural department.[25] I believe that more schools could successfully run an agricultural department. In fact, graduates from those 3 agricultural schools have high employment rates and I believe there is a strong need for more trained professionals in the field of agriculture. In this doctorate project, I am proposing to establish a new Urban Agricultural Department in Tokyo, and for example, Kogakuin University would be an ideal candidate. It is a well-known private school located in west side of Shinjuku. It has an architecture department which concentrates on global environment issues that I believe it matches its characteristics. The school will grant the

---

21. Mara Gittleman, Lenny Librizzi, and Edie Stone, "Community Garden Survey New York City," (GrowNYC, 2010), 5.

22. Ibid.

23. Michalel Tortorello, "Growing Everything but Gardeners," *The New York Times*, October 31 2012.

24. "Agricultural Department," List of Universities in Japan, http://university.info-list.net/department/agriculture.html.

25. Ibid.

urban community farming in Shinjuku for the education and research purposes, and in return, they will be responsible for maintaining healthy communities and farmlands. An agricultural department typically requires vast amount of land which metropolitan Tokyo area does not have. Therefore, it would ease the problem if a new department could have access to public areas, and there will be more need for educated urban farmers to cultivate not only food but also healthy and interactive communities.

2. Food and the City

2.1 Food Independence

This chapter focuses on the global food situation and agricultural traffic. The deeper research focuses on Japan's trends in the food independence, efforts to recover the percentage and establishment of food stability, food security, and solid wastes.

There are many concerns over world food supply and demand. A number of particular productions are concentrated in specific countries. Japan depends heavily on specific countries for its imports. The long-term food independence has decreased significantly and has remained at the lowest level for any developed country. Aiming to achieve 50% food independence by 2020, efforts should be made, not by developing undisturbed rural areas, but developing agriculture in urban area. There is an abundance of undisturbed natural land in Japan, and we should not invade those areas due to both sustainable and cultural reasons. The commonly held view that the Japanese have a 'love of nature' has been developed and repeated literally for centuries by both Japanese and observers of Japan.[26] In addition, food security has very complicated issues. There are various kinds of risks at every step of the food chain, such as the rise of new-type infections like avian flu. Fertilizers and ingredients could also terrify human lives. Since most of them are imported from foreign countries, and will not be directly consumed by the people, risk management levels are very low, which could end up in a serious situation such as the infection of mad cow disease (BSE). In the WTO agriculture negotiations, Japan should make every effort to reflect its position as a major food importer. In EPA/FTA negotiations, it is fundamentally important for Japan to take into account both economic and diplomatic benefits in such a way as to ensure a safe and stable food supply, improve its food independence and promote domestic agriculture by developing agriculture in urban areas.

26. Kinji Imanishi and Pamela J. Asquith, *A Japanese View of Nature : The World of Living Things*, Japan Anthropology Workshop Series (London ; New York, NY: RoutledgeCurzon, 2002), 1.

2.1.1 World Food Consumption and Supply

International prices of grain reached a peak from spring to summer in 2008, and then dropped significantly, due to, in addition to prospects of a good harvest of wheat, the outflow of speculative funds triggered by the global financial crisis and concern over a decrease in demand for grains caused by the worldwide economic downturn. Since the end of 2008, grain prices have shown an upward trend because of the drought in South America, the delay in crop planting in the United States due to bad weather, and a tremendous rise in the demand for imported soybeans in China (Figure 8). While the prices have brought down again since June 2009 as a result of good weather in the United States, prices as of spring, 2010 have remained 1.2 to 1.7 times as high as those in the fall of 2006.[27] With regard to global food demand and supply, both the demand for and production of grains are demonstrating an upward trend, and ending stock rates have fluctuated at a high level. In recent years, however, grain stocks have dropped almost to the lower limit of safety stock (Figure 9).

This is only an example of grain, but any type of food prices are influenced by an amount of crops over the world. Increasing the food independence will stabilize the domestic prices and secure the amount that meets the demand.

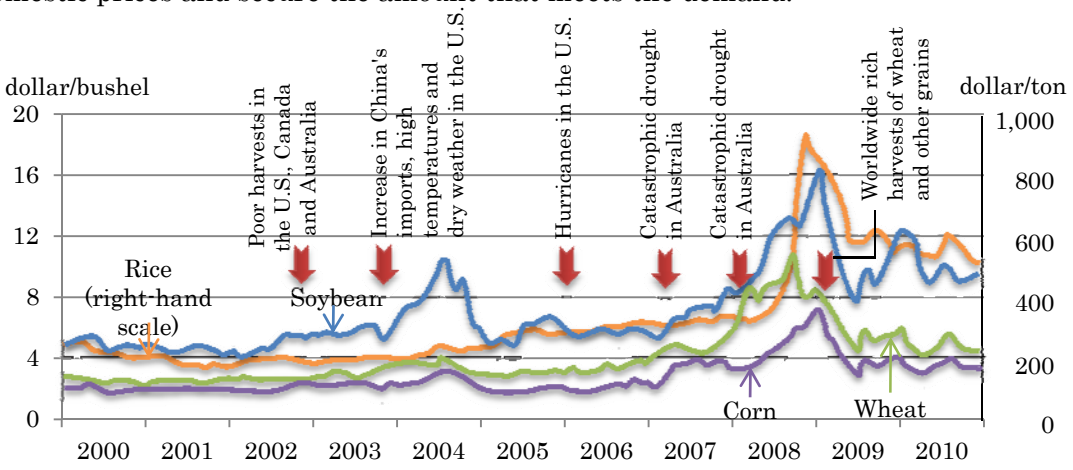


Figure 8 Changes in international prices of grains and soybeans

(Graph prepared by Takao Ugai, based on data from Ministry of Agriculture, Forestry and Fisheries, Reuters Economic News Service and the Board of Trade of Thailand)

27. United States Department of Agriculture, "Production, Supply and Distribution Database," (United States Department of Agriculture, 2011).

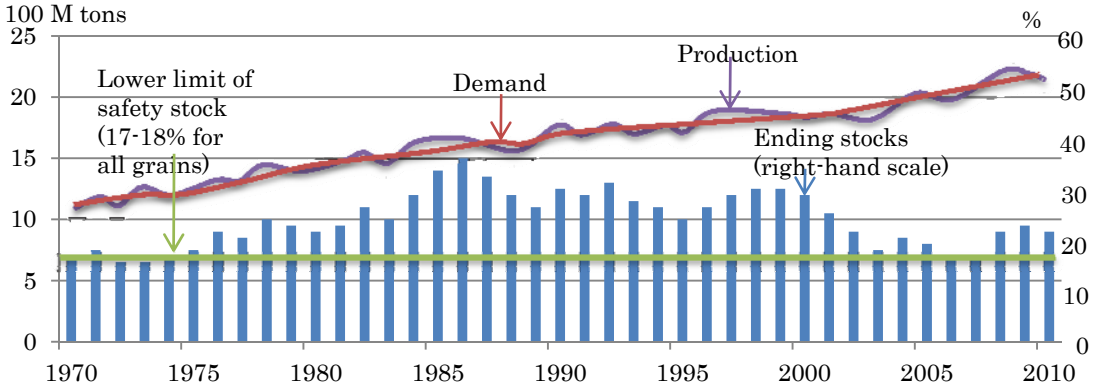


Figure 9 Changes in the production of, demand for, and ending stocks/use ratio for grain
Graph prepared by Takao Ugai, based on data from Ministry of Agriculture, Forestry and Fisheries and the United States Department of Agriculture (2009). Production, Supply and Distribution Database.

Concerns over the global food supply from both the mid- and long-term perspectives are on Figure 10. An increase in demand for foodstuffs and agricultural products increases due to population, particularly in China and India with rapid economic growth and other developing countries. The rapid increase in demand for and production of biofuels, particularly bioethanol from maize and sugarcane, has also had a number of effects on grain demand.[28] On the supply side, only a small increase in harvested areas and unit crop yields could be expected (Figure 11) if we continue the same agricultural approach. Also, the global climate change, caused by increased emissions of greenhouse gases, is likely to affect agroecosystems in many ways, but the outcome, for instance, as a shift in productivity depends on the combined effects of temperature, soil moisture, atmospheric CO_2, tropospheric ozone (O_3) and other global change components,[29] which indicates that relying solely on certain concentrated areas or countries for specific food items may very well put us in higher risk as opposed to encouraging more diversity in farming locations, methods and securing alternative sources.

28. Mark W. Rosegrant, "Biofuels and Grain Prices: Impacts and Policy Responses," in *Testimony for the U.S. Senate Committee on Homeland Security and Governmental Affair* (2008), 1-4.

29. Jürg Fuhrer, "Agroecosystem Responses to Combinations of Elevated Co2, Ozone, and Global Climate Change," in *Agriculture, Ecosystems & Environment* (Elsevier Science B.V., 2002), 20.

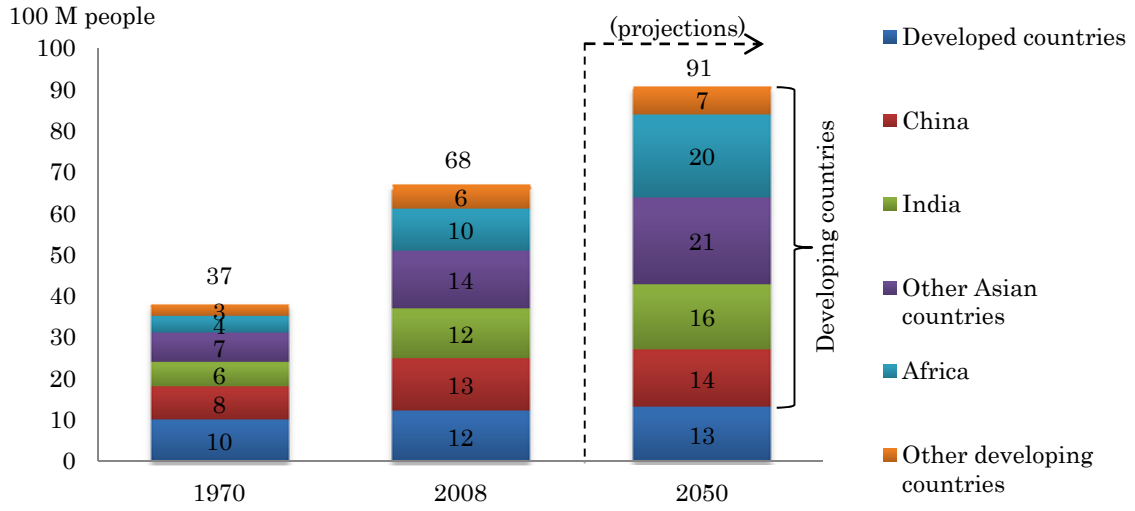


Figure 10 Changes and prospects for the population.

(Graph prepared by Takao Ugai, based on data from UN World Population Prospects: The 2008 Revision and Ministry of Agriculture, Forestry and Fisheries)

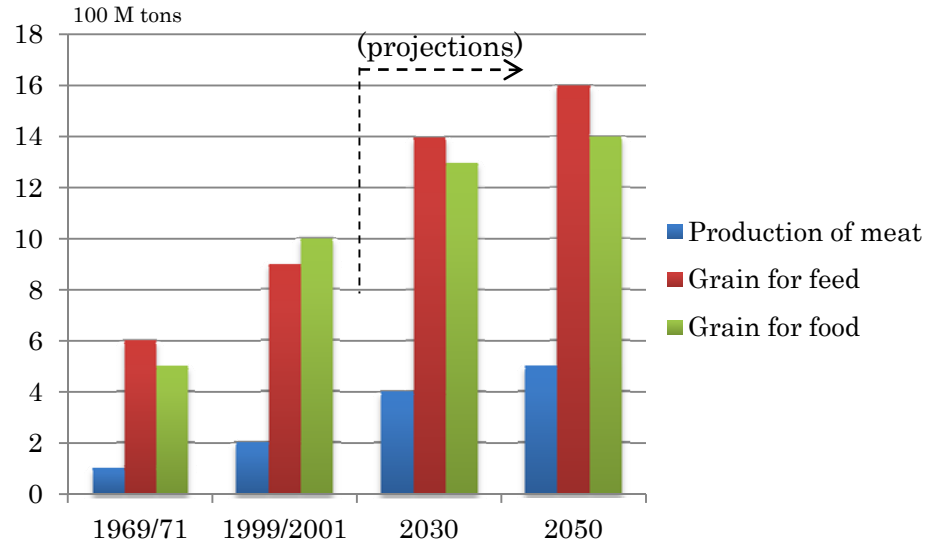


Figure 11 Changes and prospects for meat production volumes and grain demand.

(Graph prepared by Takao Ugai, based on data from Ministry of Agriculture, Forestry and Fisheries and Food and Agriculture Organization, Food and Agriculture Organization of the United Nations and World agriculture: towards 2030/2050)

Until now, the size of harvested area remained about the same from 1961, but because of the development of agronomy, unit crop yield and production have been increasing (Figure 12). Also, advanced heavy machinery helped to increase the area for each farmer, which also meant a decrease in harvested area per person. These facts indicate a potentially enormous risk due to unpredictable global climate changes; a substantial number of people could suffer from what some diminutive damages to harvested area could cause.

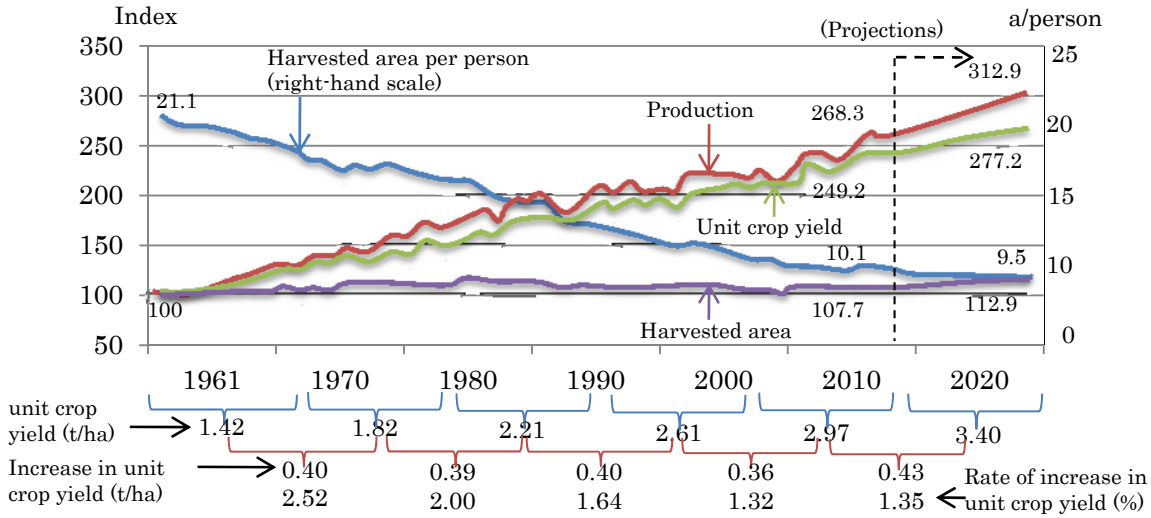


Figure 12 Changes and prospects for harvested areas, grain production and unit crop yields around the world (Year 1961 = 100)

(Graph prepared by Takao Ugai, based on data from USDA Production, the Ministry of Agriculture, Forestry and Fisheries Policy Research Institute; and the United Nations World Population Prospects: The 2008 Revision)

The production and export of grains are concentrated in specific countries (Figure 13). For this reason, poor harvest and/or crop conversion in any of the exporting countries affect the global market significantly. There is also a significant imbalance of food distribution in the world: While approximately 1.5 billion adults around the world are overweight and 200 million men and nearly 300 million women are obese,[30] 25,000

30. WHO Media centre, "Obesity and Overweight," (World Health Organization, 2011).

people die of starvation every day mainly in developing countries, yet in 2009, more than one billion people were reported to be malnourished.[31]

Japan is the largest net import country of agricultural products in the world (Figure 14). Its import of agricultural products, mainly processed foodstuffs, is constantly increasing, resulting in the appreciation of the yen and trade deregulation throughout the world, as well as more diversified diet of the Japanese. In 2008, partly accelerated by the increase in grain prices, the total value of imports of agricultural products increased significantly from ¥4.5 trillion (Figure 15). Imports from the United States, EU, China, Australia and Canada, the top five countries, account for 70% of the total import volume, showing that Japan's imports largely depend on imports from these specific countries.

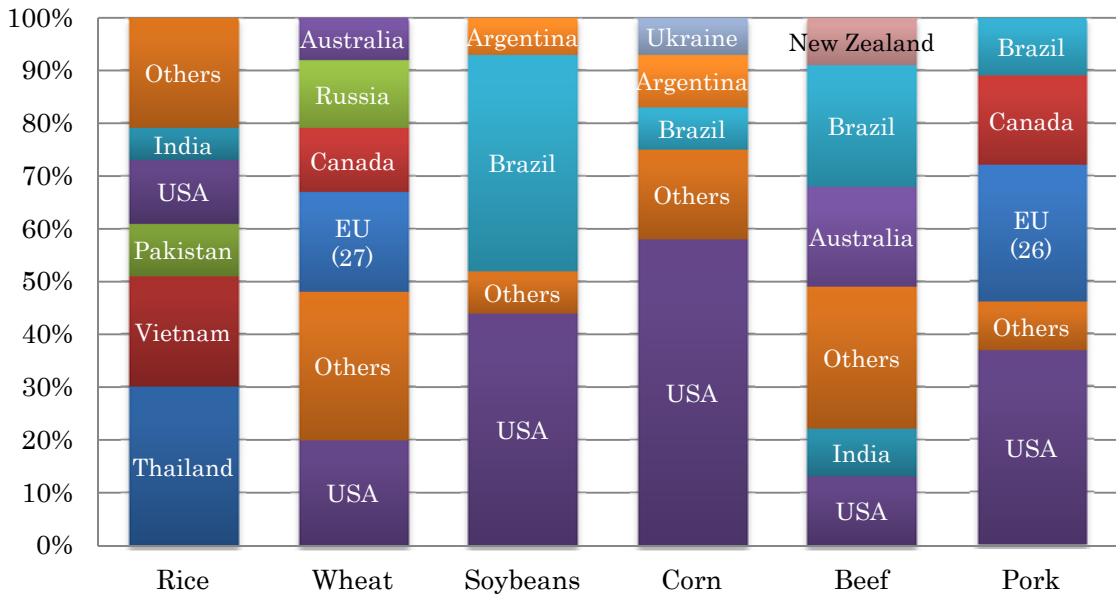


Figure 13 Percentages of countries exporting major agricultural products (2008)
(Graph prepared by Takao Ugai, based on data from United States Department of Agriculture, Production, Supply and Distribution Database)

31. "World Health Report," (World Health Organization, 2010).

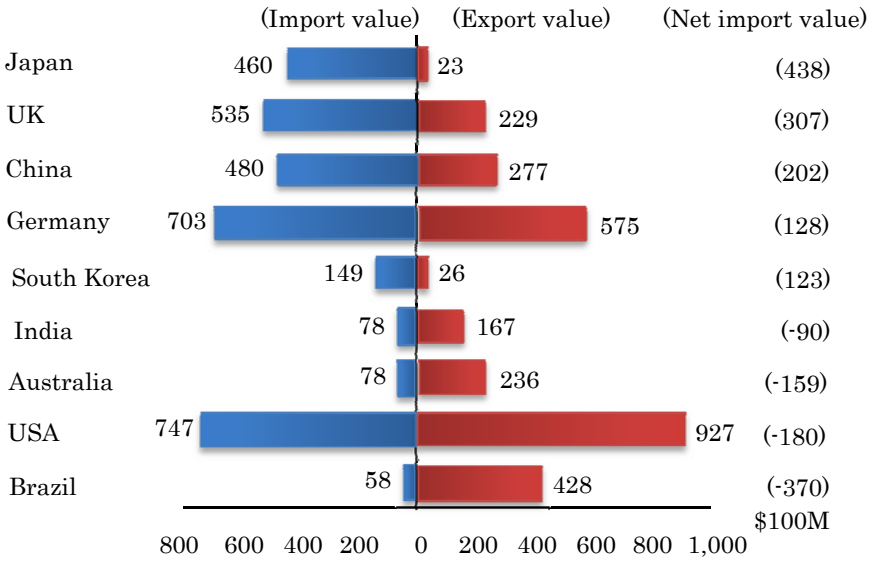


Figure 14 Import and export values of agricultural products of major countries (2007)

(Graph prepared by Takao Ugai, based on data from Food and Agriculture Organization and Food and Agriculture Organization of the United Nations)

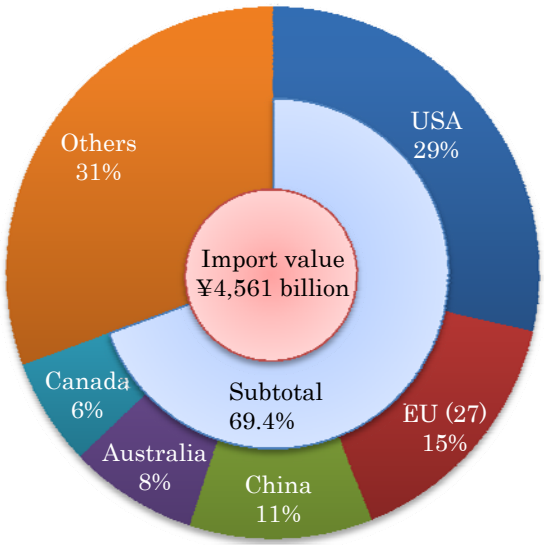


Figure 15 Major countries from which Japan imports agricultural products (2009).

(Graph prepared by Takao Ugai, based on data from Ministry of Finance, Trade Statistics of Japan and the Ministry of Agriculture, Forestry and Fisheries, Policy Research Institute)

2.1.2 Japan's Food Independence

In the last 40 years, Japanese diet has changed dramatically. The consumption level of rice has decreased which is 100% harvested in Japan. On the other hand, the consumption of livestock products consisting of corn and other feed grains, which cannot be supplied domestically, and oils and fats that use oil seeds such as soybean and rapeseed, have increased (Figure 16). The number of full time farmers and the total area of cultivated land both have been reduced significantly, mainly due to decrease in the prices of agricultural products and agricultural income, which caused a decrease of the agriculture field in both rural and urban areas. For these reasons, both in terms of consumption and production, the food independence on a calorie supply basis has significantly decreased from 73% in fiscal 1965 to 53% in fiscal 1985, and then to about 40% in recent years (Table 1). This percentage is the lowest among the developed countries. Because there are concerns in Japan about the difficulties in ensuring a mid- to long term food supply, it is necessary for the country to focus its efforts to improve its food independence as much as possible, mainly for grains that are likely to become scarce in the future. When we do so, we should not recover the pre-existed agricultural field but return those abandoned land to nature. Urban sprawl could be contracted by developing agriculture in urban rather than rural areas. Moreover, there are less and less people willing to become a fulltime farmer. The number of the fulltime farmer decreased from almost 9 million in fiscal 1965 to about 2 million in 2008, and very few young people are involved and 59% are 65 years or older. However, as stated in Chapter 1, people in urban areas have shown great interest in agriculture and are willing to practice it in their spared time.

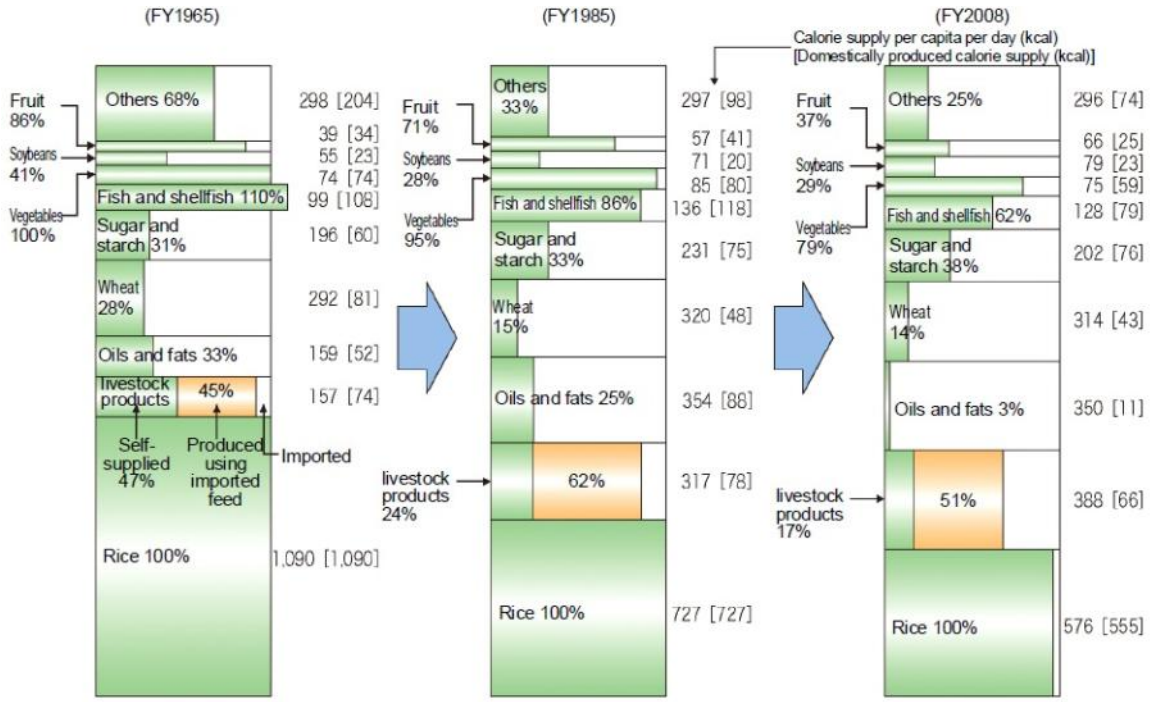


Figure 16 Changes in the Food independence in Japan by product (on a calorie supply basis)

(Source: Ministry of Agriculture, Forestry and Fisheries' Food Balance Sheet, Census of Agriculture and Forestry, Statistics on Movements in Agricultural Structure, and Statistics on Cultivated Land and Planted Area)

Table 1 Changes in the Food Independence, Number of Farmers and Cultivated Land in Japan

	1965	1985	2008
The food independence (calorie supply basis)	73%	53%	41%
Calorie supply per capita per day	2,459 kcal	2,597 kcal	2,473 kcal
Number of farm household	5,660,000	4,380,000	2,520,000
｜Commercial farm households	-	3,310,000	1,750,000
Farmers mainly engaged in farming	8,940,000	3,460,000	1,970,000
｜≥65 years old	-	20%	59%
Cultivated land	6,000,000 ha	5,380,000 ha	4,630,000 ha
Total planted area	7,430,000 ha	5,660,000 ha	4,270,000 ha
Utilization rate of cultivated land	124%	105%	92%

(Source: Ministry of Agriculture, Forestry and Fisheries' Food Balance Sheet, Census of Agriculture and Forestry, Statistics on Movements in Agricultural Structure, and Statistics on Cultivated Land and Planted Area)

The food independence on a calorie supply basis of large cities in Japan is extremely low; the rate for Tokyo Prefecture, whose population accounts for 10% of the total population, is 1%; the rate for Osaka Prefecture, whose population accounts for 7%, is 2%; and the rate for Kanagawa Prefecture, whose population also accounts for 7%, is 3% (Figure 17). These low rates indicate that it is necessary to raise more awareness of food independence among residents in large cities, as well as increase domestic agricultural production and improve the distribution infrastructure. Food Action Nippon, a national campaign to increase the food self-sufficiency ratio, is being promoted cooperatively by more than 3,000 "promotion partners" from a wide range of fields, including farmers, food manufacturers, distributors and government agencies. Projects associated with the Food Action Nippon campaign include an effort by the Rice Flour Club to increase the consumption of rice flour and products made with rice flour, and a contest "My Action Declaration" to gather ideas that will help improve food independence. The recent campaign is mainly promoting in rural areas but this activity could carry a lot of weight if it starts in urban areas like Tokyo and Osaka.

Prefecture	Population	Food Independency	Prefecture	Population	Food Independency	Prefecture	Population	Food Independency
National	100.0	41	Mie	1.5	42	Toyama	0.9	73
Hokkaido	4.4	198	Shiga	1.1	50	Ishikawa	0.9	48
Aomori	1.1	119	Kyoto	2.1	13	Fukui	0.6	64
Iwate	1.1	104	Osaka	6.9	2	Yamanashi	0.7	20
Miyagi	1.8	80	Hyogo	4.4	16	Nagano	1.7	53
Akita	0.9	177	Nara	1.1	25	Gifu	1.6	25
Yamagata	0.9	133	Wakayama	0.8	30	Shizuoka	3.0	18
Fukushima	1.6	85	Tottori	0.5	57	Aichi	5.8	13
Ibaraki	2.3	70	Shimane	0.6	64	Fukuoka	4.0	22
Tochigi	1.6	74	Okayama	1.5	37	Saga	0.7	102
Gunma	1.6	32	Hiroshima	2.2	23	Nagasaki	1.1	45
Saitama	5.5	11	Yamaguchi	1.2	33	Kumamoto	1.4	61
Chiba	4.8	29	Tokushima	0.6	45	Oita	0.9	51
Tokyo	10.0	1	Kagawa	0.8	36	Miyazaki	0.9	56
Kanagawa	6.9	3	Ehime	1.1	39	Kagoshima	1.4	84
Niigata	1.9	99	Kochi	0.6	48	Okinawa	1.1	33

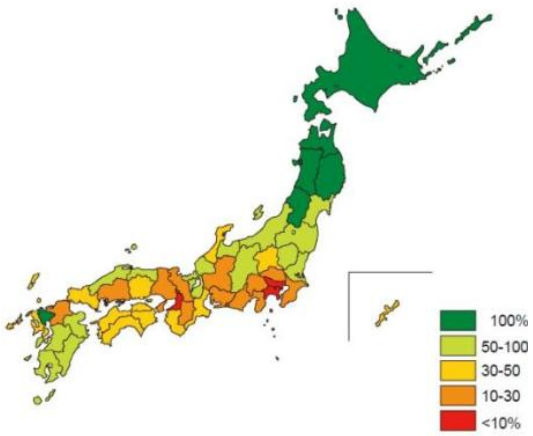


Figure 17 Food independence by prefectures

(Source: A survey by Ministry of Agriculture, Forestry and Fisheries)

This low food independence has actually caused remarkable impact. On March 11, 2011, a large earthquake and a corresponding tsunami hit the Tohoku region which is north east of Tokyo. This disaster damaged the major infrastructure and all transportation services stopped in the region. Tokyo was far enough from the epicenter that none of the infrastructures, streets and railways was damaged. However, because of the low food independence, serious deficiency of food has occurred throughout the prefecture (Figure 18). This could have been avoided dramatically minimized if they had pursued the urban agriculture.

Figure 18 Empty Supermarket (photo by Koto Lan)

2.1.3 Establishment of Food Security

In addition to mid- to long-term concerns over food supply and demand, there are also various concerns over every step of the food production-distribution-consumption process, including our dependence on overseas supply of fertilize materials, invasion and spread of pests and diseases of agricultural products and animals, emergencies of new-type infections, and acquisition of farmlands in foreign countries (Figure 19). To address these concerns appropriately, it is necessary to ensure food security comprehensively. More than one billion people are estimated to be undernourished around the world, mainly in Asia and Africa.[32] Japan promotes international cooperation to ensure global and domestic food security, promote agricultural investments, and address global environmental issues.

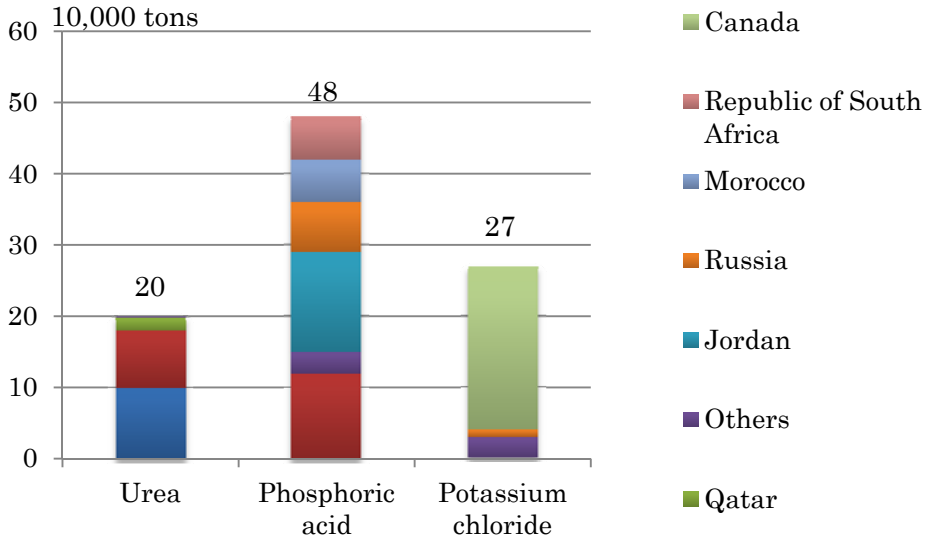


Figure 19 Countries from which Japan imports fertilizers and ingredients

(Graph prepared by Takao Ugai, based on data from Ministry of Finance, Trade Statistics of Japan)

32. Ibid.

2.2 Food Habits and Food Safety in Japan

This chapter focuses on food consumption, the food industry and eating habits; all of which have a major impact on agriculture. Food consumption as a whole has been shrinking in recent years due to falling birth rates and aging population in recent years, there has been an increasing inclination towards externalizing our diet and simpler and more convenient food preparation, as well as a growing preference for low-priced foods or fast foods, even though people are paying more attention to a healthier diet. People are exposed to more "healthy" or "organic" food ads and aware of negative effects of "hydrogenated oil" and fast food; however, today's busy work schedule and life style may be causing people to resort to quicker and faster foods despite all of the negative facts. Also, "healthier" foods can be more costly than fast foods. The food industry plays an essential role in ensuring a stable supply of food and promoting consumption of local food. They need to establish a new approach in response to food consumption trends and other changing circumstances. Eating habits have changed dramatically over 40 years due to intervention of western custom (Figure 21), which has caused problems such as poor nutrition and skipping of meals. These facts make food education all the more necessary, and creative measures are being employed throughout the country to address these problems. Measures grounded in science need to be pursued from the farm to the dining table to improve food safety. As stated in the Chapter 2.1, Food Independence, increasing local supply is crucial. Nevertheless, it is unrealistic to aim 100% food independence by geographical and economical reasons in Japan. Especially, importing food is heavily related to Japan's foreign diplomacy issues, which must be delicately maintained. Imported food involves additional steps in the food chain compared to the locally grown, and various efforts including Good Agricultural Practice (GAP), Hazard Analysis and Critical Control Point (HACCP) and other such approaches are needed to protect the food chain. Efforts to improve traceability and to provide more information through labeling are also necessary in order to ensure the safety and encourage the people to consume local food.

2.2.1 Food Consumption and Food Industry Trends

A look at food consumption trends reveals a consistent decline in Japan's per capita caloric intake from 1970. Caloric supply peaked in 1996 and has dropped in recent years. Food consumption expenditures per household member have decreased in both nominal and real amounts in recent years (Figure 20). With the shrinking and aging population, Japan's food consumption volume and expenditures are also minimizing as a whole.

The percentage of food consumption expenditures accounted for fresh food products has declined significantly, while the percentages of restaurant meals, side dishes, retort food products, boxed lunches and other prepared foods have increased, indicating growing inclination, and simplified food preparation (Figure 21).

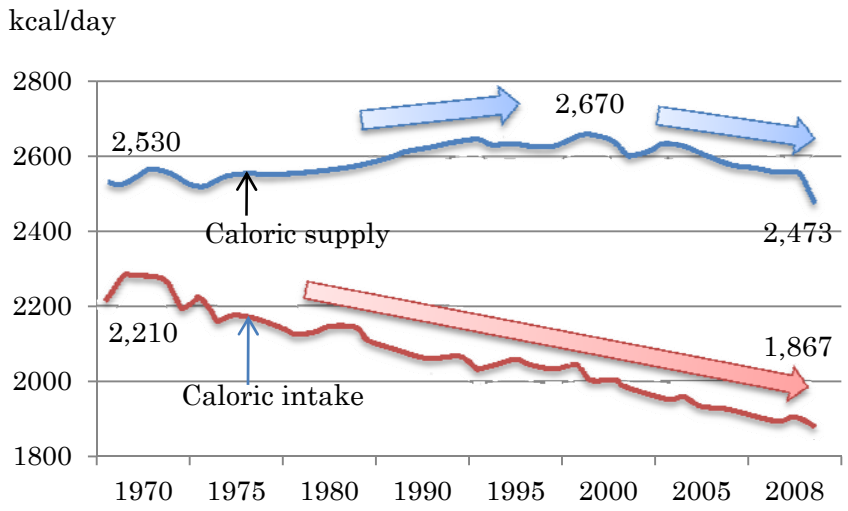


Figure 20 Caloric intake and supply per capita (Graph prepared by Takao Ugai, based on data from Ministry of Agriculture, Forestry and Fisheries and Ministry of Health, Labour and Welfare)

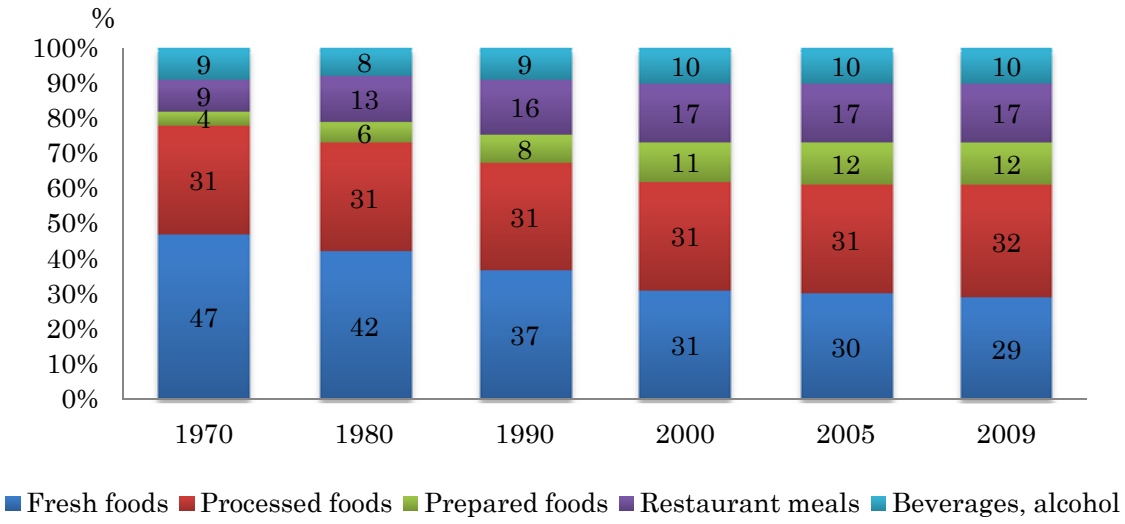


Figure 21 The change of percentage of food consumption expenditures (Graph prepared by Takao Ugai, based on data from the Ministry of Internal Affairs and Communications)

Even though economic trends in recent years are starting to show a steady recovery again, weak self-sustainability and high unemployment ratio point to a serious situation in Japan. With the consumer price index (overall, excluding fresh foods) in a downtrend, the consumer price index for food products is also decreasing (Figure 22). Examining consumer views on food reveals a rise in the percentage of consumers who place a priority on economy from 27% in 2008 to 43% in 2010, while those favoring domestic production has diminished from 18% to 12%, and safety from 41% to 16% (Figure 23).[33] There has thus been in recent years a focus on economy and a tendency to eat at home as economic conditions worsen. As food prices drop, a slump can be seen in the profits of food-related companies, generating concerns of a deflationary spiral in the food sector as well (Figure 24). This circumstance has a major impact on farm family income through lower sale prices for agricultural produce, and it is one of the reasons to decrease the number of farmers. It is a very harsh reality for the farmers with current economy and food chain cycle that farmer's style needs to be revised; more part time farmers in urban rather than full time in the rural areas.

33. Japan Finance Corporation, "Consumer Trend Survey," (Japan Finance Corporation, 2010).

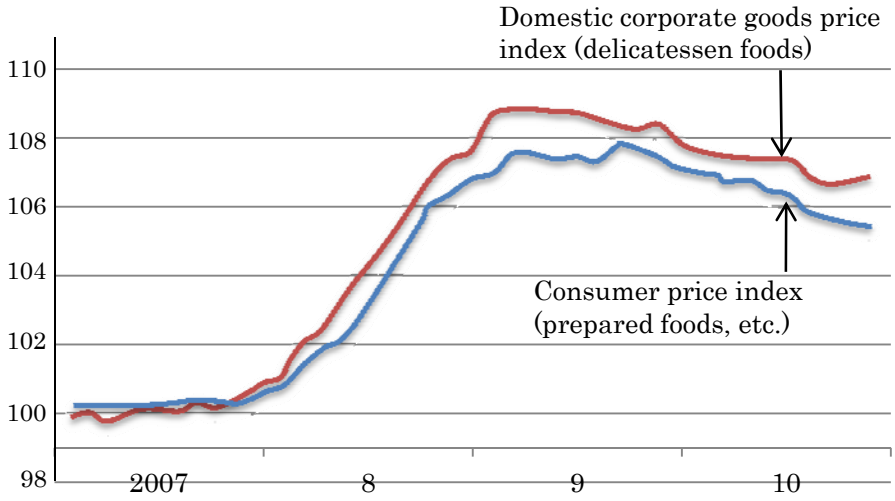


Figure 22 Food Price Index (2005=100) (Graph prepared by Takao Ugai, based on data from Ministry of Internal Affairs and Communications and Bank of Japan)

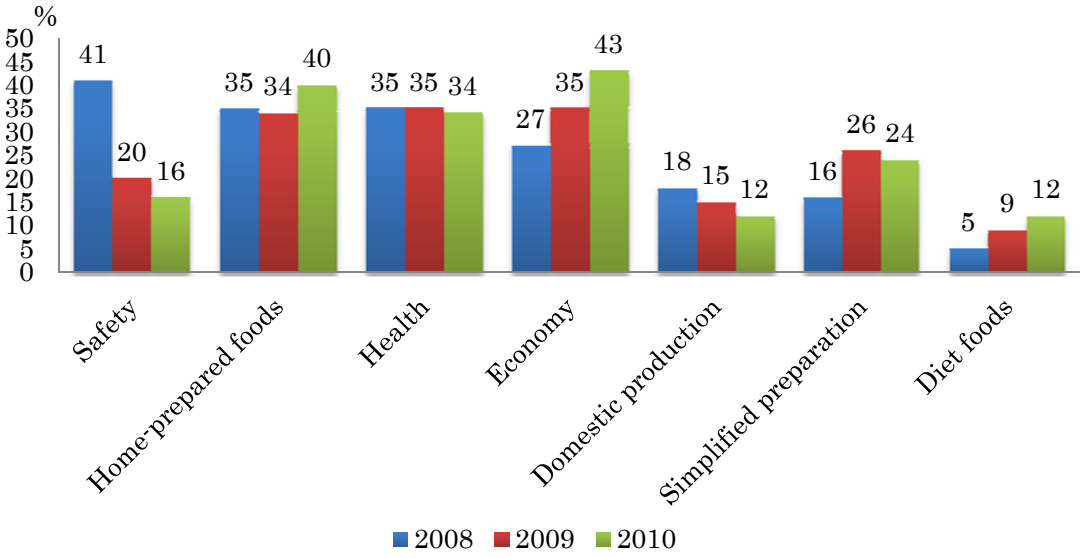


Figure 23 Changes in consumer preferences regarding food (multiple answers possible) (Graph prepared by Takao Ugai, based on data from Japan Finance Corporation)

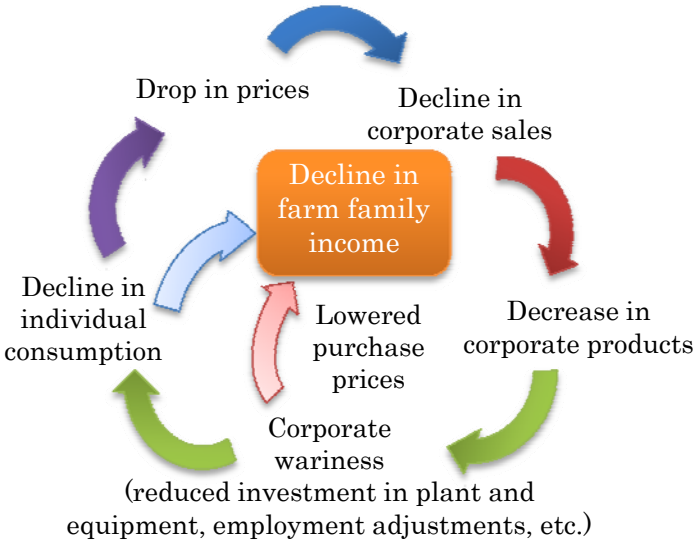


Figure 24 Image of Deflationary Spiral (Figure prepared by Takao Ugai)

The food industry is responsible for ensuring a reliable supply of food essential to national livelihood and also plays important role in economy and employment. In regions where the agricultural and fishery industries represent a large percentage of the total production of all economic activities, the food industry also represent a large percentage, occupying an important place in the local economy. The greatest demand for domestically-produced agricultural, forestry and fishery products comes from the food industry, as evidenced by the fact that more than two-thirds of those products are delivered to the food manufacturing industry and the food service industry (Figure 25). Overall sales of food products in convenient stores are rising constantly, which indicate that more people are willing to buy prepared foods at the small convenient stores near their homes or offices (Figure 26). Expanding the scale of the domestic market will be rather difficult, but there is an increasing need to reinforce the operating base in order to address consumer safety and health, inclination towards simplified food preparation, preference for low-cost products, growing procurement risks for primary agricultural produce, expansion of emerging markets in Asia and elsewhere, and environmental issues. Further rationalization and greater efficiency in food product distribution are required, more advanced quality control needs to be established using cold chain systems, and the functions of wholesale markets need to be strengthened by endorsing transparency of transactions, and pursuing rationalization.

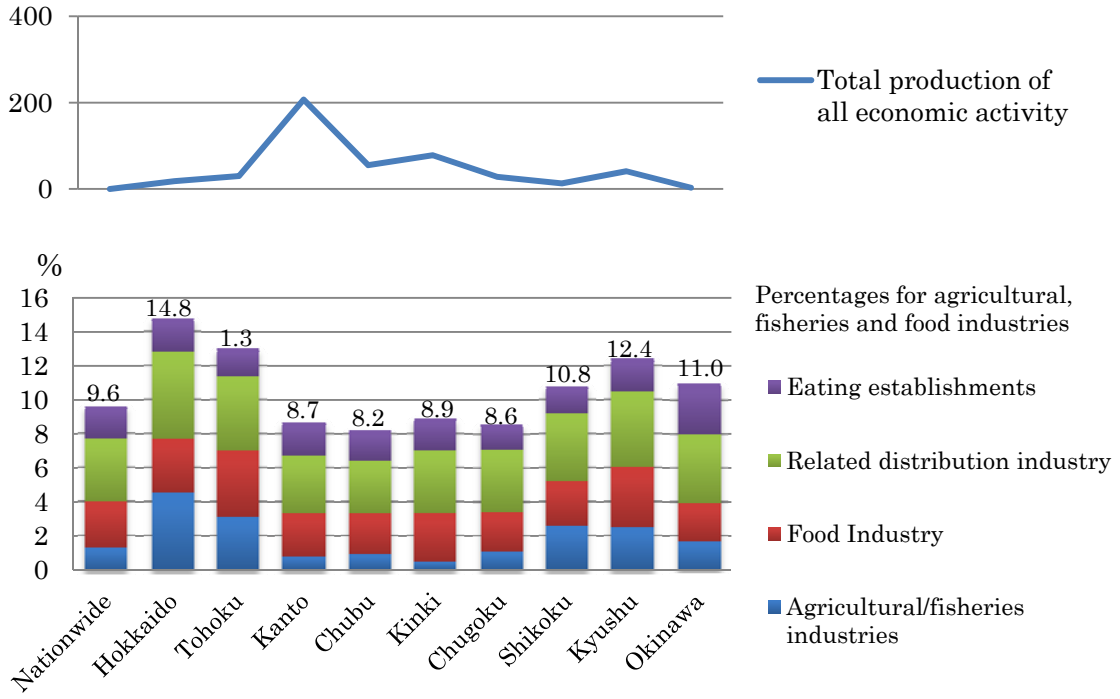


Figure 25 Percentage of total production of all economic activity accounted for by food industry (2005) (Graph prepared by Takao Ugai, based on data from nine government organizations, including Ministry of Internal Affairs and Communications and Ministry of Economy, Trade and Industry)

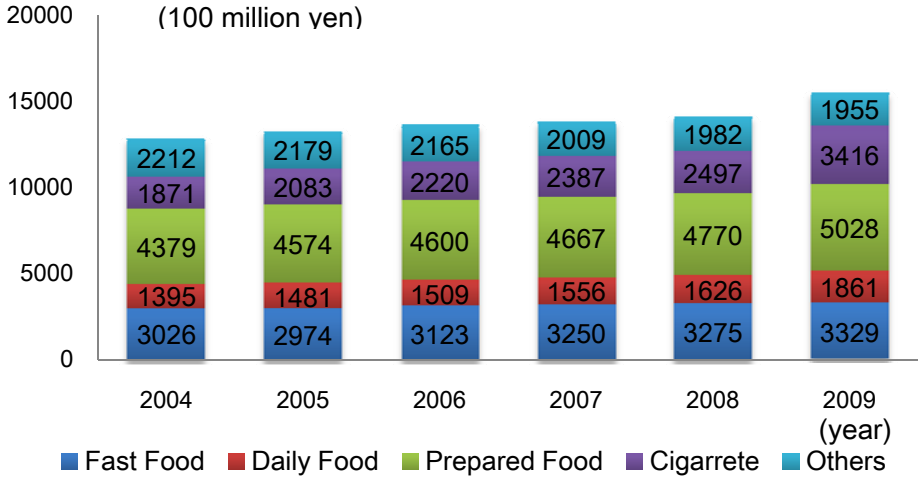


Figure 26 Change in food product sales in convenient stores (Graph prepared by Takao Ugai, based on data from Lawson Incorporation, 2009 database of annual amount of sales transition)

2.2.2 Dietary issues and "Shokuiku" (food and nutrition education)

The Japanese dietary pattern, which consists of rice as a staple food, combined with a variety of other foods, such as fish, fruits, vegetables, meat and milk, was formulated by around 1980. This dietary pattern was well-balanced from nutritional point of view; however, today, we find that the ideal dietary pattern has been totally eroded. (Change of protein, fat, and carbohydrate (PFC) nutritional balance.) According to Ministry of Health, Labour and Welfare, younger generations tend to consume more fat in their daily meals compared to elderly people (Figure 27). Also, the number of people potentially and likely suffering from diabetes has increased from 13 million in 1997 to 22 million in 2007 (Figure 28). With regard to dietary habits, skipping of breakfasts has surfaced as a problem. About 20-30% of the people in their 20's and 30's are not eating breakfast (Figure 29). This trend is still continuing, and this dietary habit is one of the causes of an increase of lifestyle-related diseases. "Shokuiku" is an important means of gaining knowledge and sense of awareness about food and practicing healthy life. In 2008, only 18% of the people applied The Japanese Food Guide Spinning Top to their diet to achieve a desirable nutritional balance.[34] It is important to use the Japanese Food Guide Spinning Top to make appropriate dietary habits. Among the "local production for local consumption" approaches taken to encourage communities to consume local agricultural produce, the use of local produce in school lunches has only reached 23%, necessitating further collaboration with relevant institutions and other efforts.[35]

The increasing number of people suffering from diabetes has close relationship with the concurrent trends, such as dietary changes and television and computer infatuations. However, there is a growing evidence that the physical features of cities discourage physical activity and thereby contribute to this epidemic.[36] In addition, more and more schools are bringing in the agricultural practice in their education courses. According to the Board of Education in Japan, by involving with the food production

---

34. "National Health and Nutrition Survey," (Ministry of Health, Labour and Welfare, 2008).

35. "Survey on Utilization of Local Produce in School Lunches," (Ministry of Education, Culture, Sports, Science and Technology, 2010).

36. Howard Frumkin, Lawrence D. Frank, and Richard Jackson, *Urban Sprawl and Public Health : Designing, Planning, and Building for Healthy Communities* (Washington, DC: Island Press, 2004), 122-28.

processes, children tend to eat more vegetables, and have less faddiness for the entire lifetime.

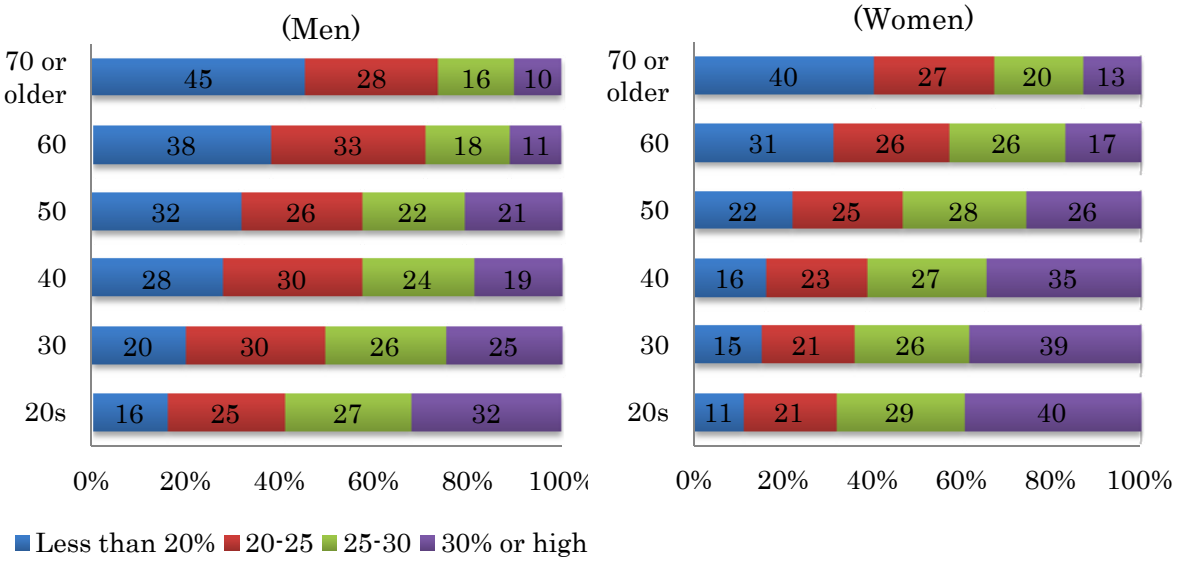


Figure 27 Fat Energy Ratios by Age (2008)

(Graph prepared by Takao Ugai, based on data from Ministry of Health, Labour and Welfare)

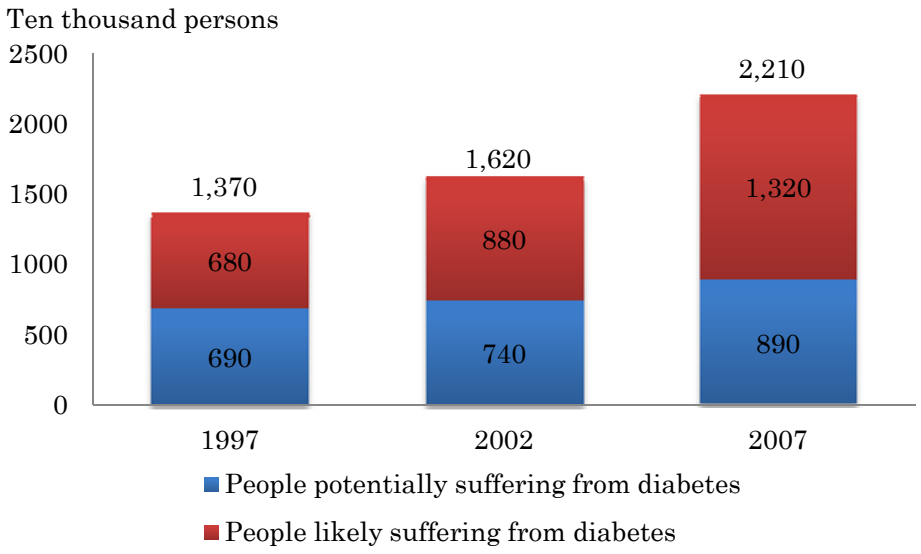


Figure 28 People Likely or Potentially Suffering from Diabetes

(Graph prepared by Takao Ugai, based on data from Ministry of Health, Labour and Welfare)

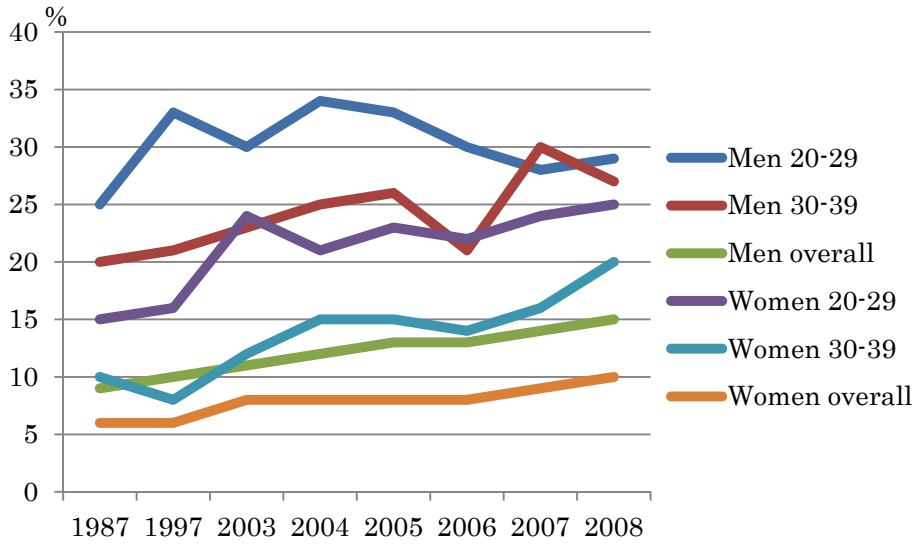


Figure 29 Rate of Breakfast Skipping (Graph prepared by Takao Ugai, based on data from "National Health and Nutrition Survey" published by Ministry of Health, Labour and Welfare)

2.2.3 Ensuring Food Safety and Consumer Confidence

With the understanding that the idea of “an ounce of prevention is worth a pound of cure” is central to the improvement of food safety, occurrence of food safety hazards should be surveyed and science-based measures should be presented as guidelines. Among the approaches needed to improve safety "from farm to fork" are shown on Figure 30. At the agricultural production stage, Good Agricultural Practice (GAP), in which it refers to the accurate implementation of an established list of requirements in laws and regulations relevant to agricultural production, accompanied by recording, checking, reviewing and continuous improvement of relevant processes. In the food processing/distribution stage, Hazard Analysis and Critical Control Point (HACCP), a systematic approach to ensure product safety through the continuous monitoring and recording of processes, is particularly important for hazard prevention, from the receipt of ingredients through manufacture and shipping. To facilitate the rapid withdrawal and recall of food products in the event of food incidents and to ensure distribution routes are not connected with the incident, individual business operators need to improve traceability by preparing and keeping transactions on record. With respect to rice and rice products, the law was passed and put in effect in October 2010 for keeping transaction records and relaying information regarding places of origin.

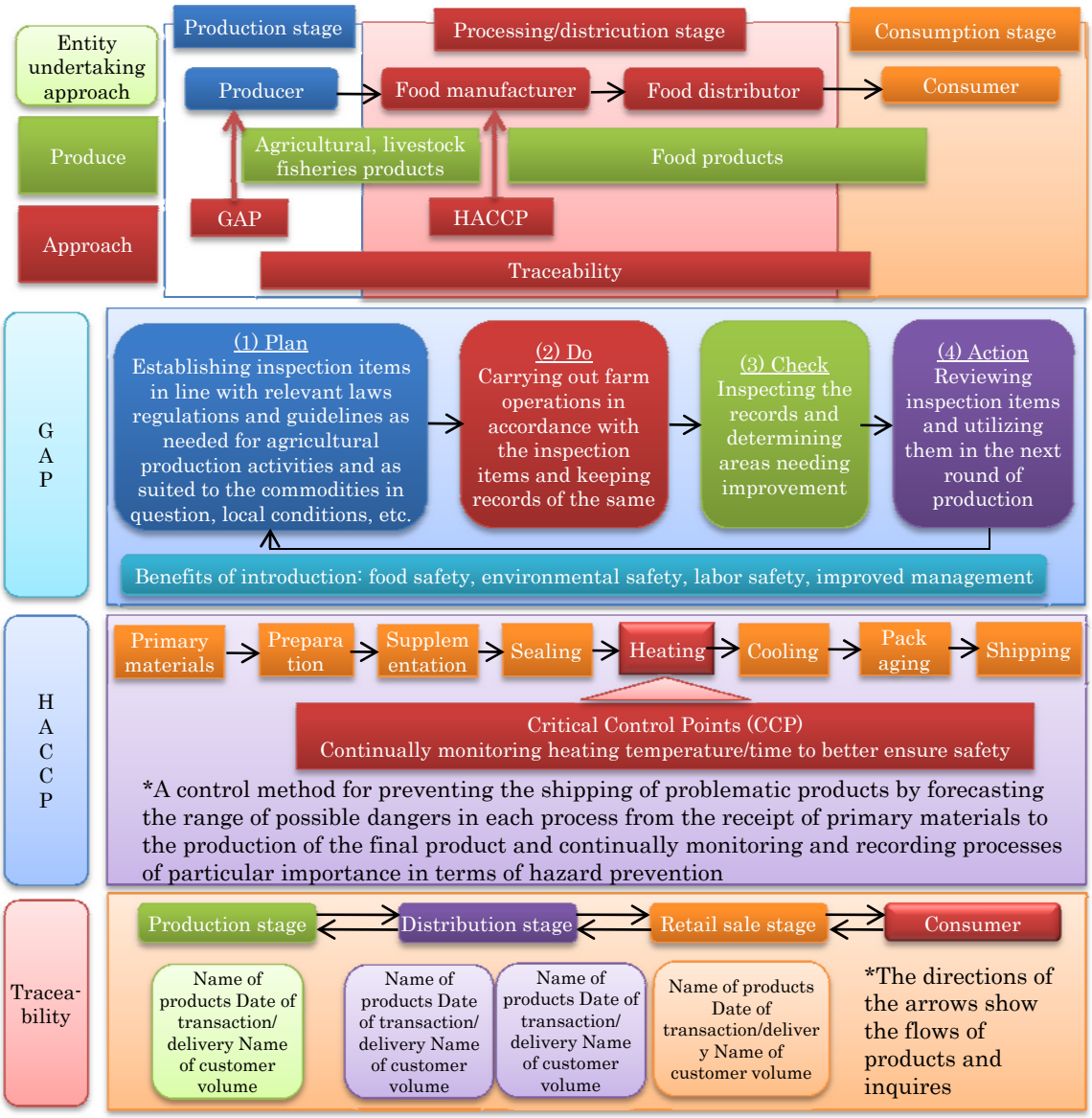


Figure 30 Overview of Approaches in Food Chain

(Graph prepared by Takao Ugai, based on data from Ministry of Agriculture, Forestry and Fisheries)

Food labels are very important sources of information for consumers when selecting products. Successive discoveries of improper labeling made consumers call for intensified surveillance and expand the scope of source/country of origin labeling. We must consider requiring food companies to provide more information and to be more proactive in labeling source/country of origin for processed food products. That will enable us to attract more locally grown and processed foods regardless of prices and strengthen support of the local agricultural industries.

It is unrealistic for Japan to aim 100% food independence due to geographical and economical reasons. Even by applying the Cultivating Urbanism to all of the major cities in Japan, it will still be necessary to import food from foreign countries. In addition, importing food is heavily related to foreign diplomacy issues, which binds Japan to continue importing from some countries. Ministry of Health, Labor and Welfare quarantine stations have received around 1.8 million import notifications in recent years (Figure 31). As steps to ensure the safety of imports become even more important, monitoring systems must be bolstered; ex-post factor approaches must be taken through bilateral agreements with exporting countries; information must be systematically collected; and on-site studies of food products exported to Japan needs to be conducted from the perspective of prevention.

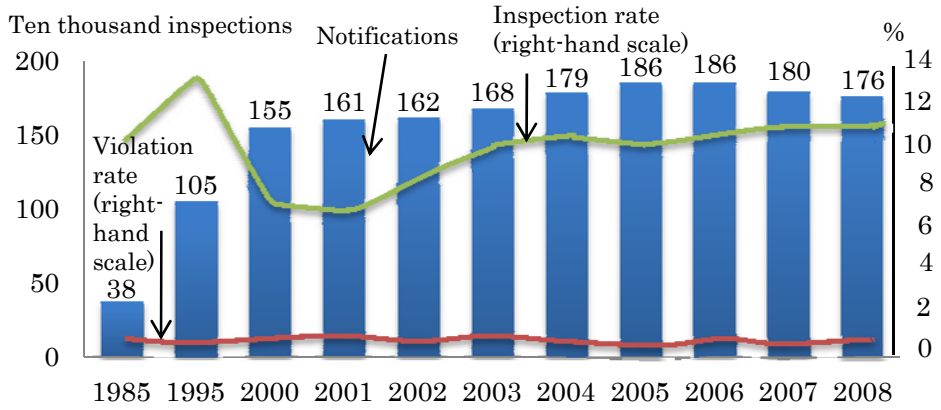


Figure 31 Number of import notifications and inspection rate of imported foods
(Graph prepared by Takao Ugai, based on data from *"Import Monitoring Statistics,"* published by Ministory of Health, Labour and Welfare)

2.3 Solid Waste

2.3.1 Recent Issues

The issues regarding solid waste are serious among the world but especially in Japan due to high population with very small land. The U.S. manages to produce a quarter of the world's waste despite the fact that its population of 300 million is less than 5% of the world's population, according to 2005 estimates.[37] The U.S. accumulates at least 236 million tons per year of municipal solid waste alone, according to the U.S. Environmental Protection Agency. According to the each country's Environmental Agency or Ministry, the worst countries that produce the solid waste are U.S., Russia, Japan, Germany, and so on (Table 2). This data shows that Japan only produces less than 1/4 of U.S. However, when we look into the details of the data, the amount of burned up waste is enormous.

(million tons)

U.S.	236
Russia	207
Japan	52
Germany	49
U.K.	34
Mexico	32
France	32

Table 2 World's Worst Waste (source: World Watch Institute)

Generally, the burned up waste is the sum of the all solid wastes that will not be recycled. Japan holds the largest number of incinerator plants due to their high demand (Table 3). [38] In average, 1kg of solid waste is produced by individual per day which adds up over 320kg (705 pounds) per year.[39] It is the highest in the world, and three times more than the U.S. (Table 4). In order to burn all of these wastes, it requires 2.5 billion dollars (193

Japan	1243
U.S.	351
France	188
Germany	154
Sweden	28
U.K.	55

Table 3 Number of incinerator plants (source: worldbank.org)

37. Robert Malone, "World's Worst Waste," http://www.forbes.com/2006/05/23/waste-worlds-worst-cx_rm_0524waste.html.

38. "Oecd Annual Report 2008," (Organisation for Economic Co-operation and Development, 2008).

39. Ibid.

billion yen) every year.[40] That is about $200 per person in Japan.

Not to be argued, it also makes Japan to be the highest emissions of dioxin from waste in the world.

There are many aspects and reasons to this, but according to Ministry of the Environment, it is primarily due to the people's lack of understanding.

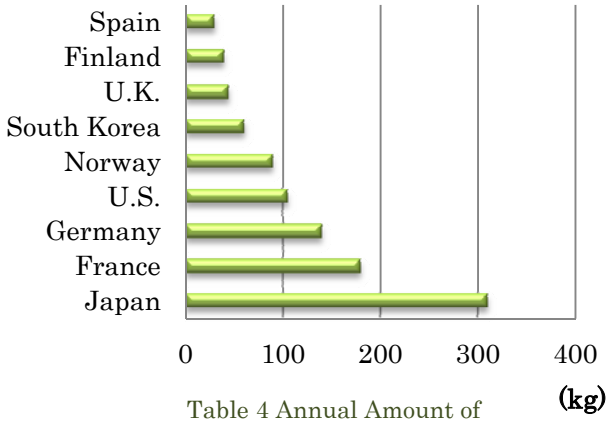


Table 4 Annual Amount of Incineration per Person

The most popular principle of reducing waste in the world is 4R: Reduce, Reuse, Recycle and Recover.[41] It is very essential to educate and provide better resources to reduce their solid waste not only for their economy but also for the global environment.

2.3.2 Urban Agriculture and Solid Waste

The interests of urban waste reduction mesh well with the urban agriculture. The urban farmers are in need of organic matter as wealthy soil conditioner/fertilizer and animal feed, and cities and towns wish to conserve disposal space and reduce the amounts of solid waste. It is truly ecological which develops the food chain within urban areas. Full range of local domestic, institutional, commercial, solid waste, with small industries' waste, biomedical waste, human and animal excreta could be turn into compost.[42]

The state of Karnataka in India has a simple proverb: "waste is food."[43] In traditional settlements in many parts of the world, the age-old habit of returning

40. Trade and Industry Ministry of Economy, "Cost of Solid Waste Treatment," http://www.meti.go.jp/.

41. "Reduce, Reuse, Recycle and Recover Waste: A 4r's Guide," ed. Daniel Dickey (Wendake, Quebec: First Nations of Quebec and Labrador Sustainable Development Institute, 2008).

42. Michael Hamm and Monique Baron, *Developing an Integrated Sustainable Urban Food System: The Case of New Jersey, United States*, For Hunger- Proof Cities: Sustainable Urban Food Systems (Ottawa: International Development Research Centre, 1999), 54-59.

43. B.B. Hosetti, "Urban Agriculture and Solid Waste Management," in *Prospects and Perspectives of Solid Waste Management* (New Delhi: New Age International Publishers, 2006), 193.

household wastes to the food chain persists. Kitchen peelings and food leftovers are fed to animals, selected organics are fed into fish ponds, and wastes are composted for home gardens.[44] Where there is intensive farming in urban areas, which typically receive solid waste, the farmers frequently exploit the products of solid waste decomposition in various ways. In addition to old practices, others, such as community vermin-composting (composting through worm culture), are growing in the urban areas of some regions like South Asia and Andean countries.

The following table lists the main types of solid waste reuse in urban agriculture with comments on the practices.

Types of solid waste, (or site)	Materials included	Practices	Comments
Kitchen, restaurant and canteen food wastes	Raw peelings and stems, rotten fresh fruits and vegetables and leftover cooked foods	Food waste may be fed to animals within the house or compound, or deposited on nearby dumps for animals to forage. Also sold for commercial use.	Direct feeding of household livestock is probably rather low-risk.
Regular mixed municipal	Full range of local domestic, instit'nl, commercial solid wastes, with small industrial wastes, biomedical wastes, excreta	In South-east and South Asia farmers buy solid waste off garbage trucks and apply it to soil, immediately or after 5-14 days.	In China, farmers are told to compost the wastes before applying to the soil, but this may not be done long enough to kill pathogens and parasites
Kitchen and yard wastes	Kitchen wastes with some garden trimmings, grass cuttings	Backyard composting for home gardening, domestic animals (poultry, pigs goats, cows)	Kitchen wastes composted over long periods may concentrate pesticide residues in plants grown in home gardens
Kitchen, yard wastes from community households and shops	Organic waste, but may contain other household waste as waste separation is often not done thoroughly	Cooperating household and institutions are asked to separate organic wastes for community compost heaps	Compost heaps are located on vacant land, parks. Few projects have infrastructure to reduce hazards such as leachate. Rodents are attracted to compost piles, for food, warm nesting places in winter.
Mixed municipal waste delivered to centralized compost plants	Mixed municipal waste which may contain problematic levels of plastic film, small industries' wastes, broken glass, batteries	Compost is collected from centralized (municipal) plants by farmers, sold, or used in municipal parks, golf courses, etc.	Most centralized composting plants have either failed or are operating at low capacities. Products are hard to sell due to glass splinters and plastics. Where thorough testing has been done of compost

44. Ibid., 193-94.

	and fluorescent light starters.		from mixed wastes in large cities, plants have often been closed own due to heavy metal contamin'n.
Kitchen and yard wastes delivered to vermicom-post (VC) projects	Same materials as for small scale community composting	Compost is sold or distributed from small vermin-culture projects, often located in parks.	VC is growing in popularity. Little known of health risks-pathogens, para.eggs, viruses may not be destroyed under the cool conditions of VC.
Old garbage dumps	Most is well-decomposed waste, often several years old. In areas of high recycling, extensive waste recovery, there may be relatively little synthetic materials in the natural compost.	The original use of "garbage farming" referred to the practice of converting old garbage dumps to farm plots. Garbage farming represents the most extensive use of solid waste for food production in the world today.	Provided the dump did not receive much industrial waste, farming on old dumps may be low risk in terms of infection. Injuries from sharps are common. Respiratory problems from dust.
Removal from garbage dumps	Well decomposed mixed municipal wastes	Nearby farmers collect compost from old dumps or closed sections of current dumps.	A large garbage hill opposite the city produce market in Yangon is being gradually eliminated by the mining of compost.
Cow dung	Cow dung	Cow dung is used as fertilizer and as a binding ingredient in plaster made of mud.	
Park and verge trimmings, swept leaves	Twigs, grass, leaves, branches, etc.	These wastes are used as animal fodder or fuel.	In some cases, these wastes are taken by the municipal authority directly to a compost plant.
Agricultural wastes	Predominantly agricultural residues produced by farming, but municipal wastes may be used to a small extent.	Integrated organic waste recycling and aquaculture is mainly practised in South China in peri-urban sericulture-fish-vegetable-poultry-pig farms.	Usually contaminated with pesticides and herbicides. The effects of concentration in compost are not known.
Fruit seeds from garbage dumps	Fruit seeds	Seeds are collected for horticulture and direct sale.	This was promoted as an urban agriculture activity in the Jati Dua project in Bandung in the 1980s.

Table 5 Main Practices of Urban Organic Waste Reuse

(Provided by Canada's Office of Urban Agriculture)

There are some tensions occur between public health officials. They are concerned about the diseases affecting both humans and animals and accidents associated with the reuse of municipal solid wastes. The safety of compost generated from multiple sources, and other risks associated with composting, mainly depends upon the following factors: a) the thoroughness of separation of organics at the household and institutional level; b) the care taken in the composting process; c) the general health of

the waste generators; d) levels of immunity acquired by consumers of foods grown on the compost; e) accumulation of pesticides in organic residues (little is known about the associated risks.)[45]

My assumption advocates that the marriage of urban agriculture and waste solid reduction/treatment could contribute to the economy, global environment in a safe and healthy manner. Nevertheless, the summary information presented here shows that there are legitimate concerns that must be addressed in the management and facilitation of agricultural and waste management practices.

The health issues regarding solid waste and agriculture are quite complicated as stated in this chapter. My preliminary suggestions are to create the central compost plant in urban area that will collect all of the valuable solid waste, separate/treat/turn them into compost, and distribute the safe/healthy compost to the public.

45. Christine Furedy and Tasneem Chowdhury, "Solid Waste Reuse and Urban Agriculture--Dilemmas in Developing Countries: The Bad News and the Good News" (Ryerson Polytechnic University, 1996), 1-5.

3. Potentials of Cultivating Urbanism

3.1 Physical and Psychological Impact of Cultivating Urbanism

This chapter focuses on how the Cultivating Urbanism impacts the people. The benefits of the plants have been widely discussed over the years. By researching and analyzing physical and psychological impacts of plants, we can realize a valid reason to integrate the agriculture into urban areas.

3.1.1 Physical Impacts to Environment

Irradiance reduction by use of plants is one of the most direct and effective methods because plants can modify the surrounding climate and save the use of air conditioning. The ability of plants to intercept incoming solar radiation is impressive. Even some leafless deciduous trees in winter can cut down up to 60% or more of irradiance.[46] Higher interception of radiation, by 70% to 90%, can be achieved by trees with dense foliage.[47] The fact that plants prevent most solar radiation from striking surfaces such as concrete, brick and asphalt implies lower surface temperatures of shaded areas and lower energy usage for space cooling. Many researches show that roughly 2.5% to 8% savings on air conditioning can be achieved with plants strategically placed around buildings.[48] From a thermal comfort point of view, the shading effect provided by plants can also reduce the overall radiation absorption by inhabitants through lowering both direct and diffused radiation absorption.

46. G. M. Heisler, "Energy Savings with Trees," *Journal of Arboriculture* 12(5)(1986): 113-25.

47. Akira Hoyano, "Climatological Uses of Plants for Solar Control and the Effects on the Thermal Environment of a Building," *Energy and Buildings* 11, no. 1–3 (1988): 184-85.

48. J.R. Simpson, "Improved Estimates of Tree-Shading Effects on Residential Energy Use," *Energy and Buildings* 34(2002): 1070.

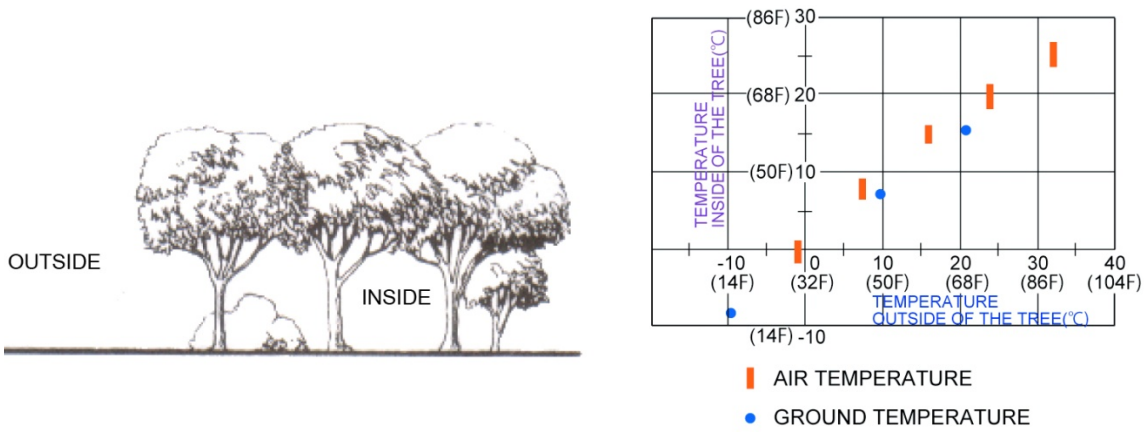


Figure 32 Temperature difference between inside and outside of trees

(Image prepared by Takao Ugai, data extracted from C. G. Ramsey and H. R. Sleeper, Architectural Graphic Standard, 6th Edition (1970))

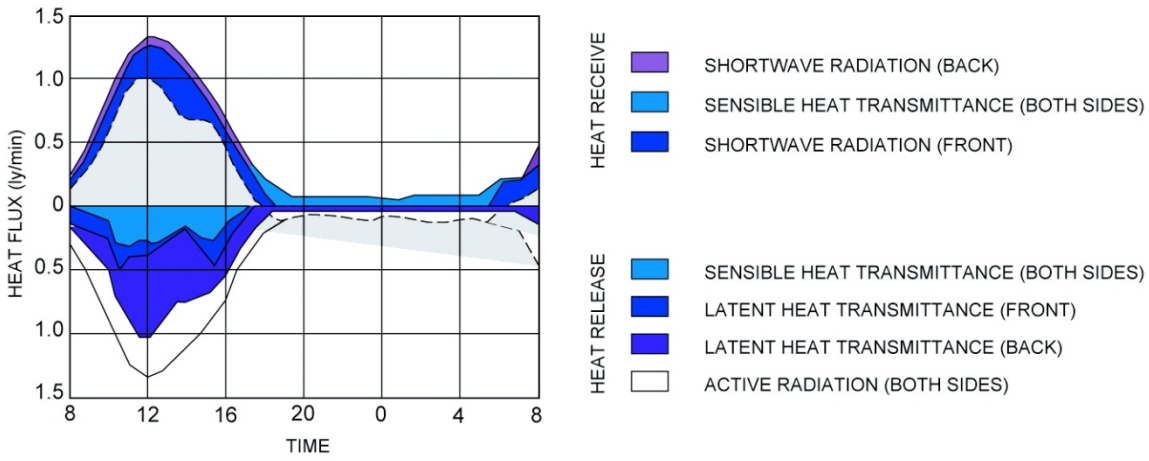


Figure 33 Foliar heat receive and release

(Image prepared by Takao Ugai, data extracted from Japan Agriculture Meteorologic Hand Book (1974))

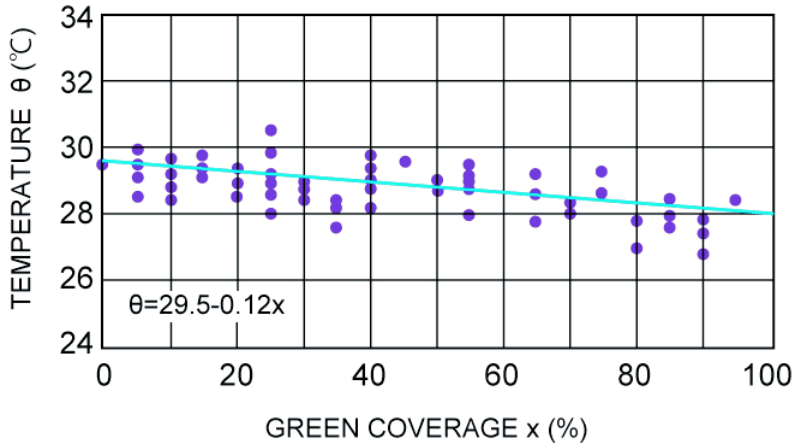


Figure 34 Observational data of relationship between green coverage and temperature
(Image prepared by Takao Ugai, data extracted from Suzuki and Maezaki, Green Lung Effect on Urban Temperature, Japan Grove Institute Literature)

Carefully designed agriculture can reduce unfavorable wind velocity. In an open space, an area within twelve times the height of tree belt can be protected from wind forces perpendicular to the plants.[49] Reduction of wind load on buildings and improvement of microclimate can be achieved in this manner. However, plants may play negative impacts in reducing wind speed. Infiltration of outside air, effectiveness of natural ventilation and convective cooling of building surfaces will be influenced.[50] This issue requires a serious attention since air movement is an important factor in determining human comfort.

The air tends to be more humid when water is slowly released by plants through the process of transpiration to the surrounding environment and leads the reduction of air temperature. The increase of the moisture content in the air can benefit temperate cities, where a relatively dry condition is experienced, to achieve better comfort.[51] However, increased humidity in the tropics may worsen the high-humidity condition in

49. N. J. Coppin, I. G. Richards, and Construction Industry Research and Information Association., *Use of Vegetation in Civil Engineering* (London ; Boston: Butterworths, 1990).

50. H. Akbari, "Shade Trees Reduce Building Energy Use and Co2 Emissions from Power Plants," *Environ Pollut* 116 Suppl 1(2002): 119-26.

51. A. Bernatzky, "The Contribution of Trees and Green Spaces to a Town Climate," *Energy and Buildings*, no. 5 (1982): 1-10.

cities. It is generally believed that increased humidity will also increase discomfort in hot climates since the loss of metabolic heat via evaporation will be limited, and people require a lower temperature for comfort.[52] On the other hand, there is no definite data showing that the increased moisture content in cities is the result of agriculture. Instead, researchers are inclined to believe that more anthropogenic moisture sources, the more urban temperature and the water usage in an urban environment there will be, which are the possible reasons for observing a "moisture island effect."[53]

Plants have been widely believed to be effective scavengers of both gaseous and particulate pollutants from the atmosphere in the urban environment.[54] They can improve the air quality by filtering out airborne particles in their leaves and branches as well as absorbing gaseous pollutions through photosynthesis. Inorganic materials (hardscope in the cities) are not able to remove pollutants in this manner. For example, it has been estimated that in Chicago, about 5,575 Mg of air pollutants, which include 22.3 Mg of carbon monoxide, 706 Mg of sulfur dioxide, 806 Mg of nitrogen dioxide, 1,840 Mg of PM_{10} (particles with an aerodynamic diameter of 10 um or less), and 2,000 Mg of ozone, were removed by urban forest in 1991.[55] The efficiency of cleansing air is decided very much by the species and the amount of urban greenery. A study of two United Kingdom cities showed that reduction of PM_{10} by 18 to 20% can be achieved when areas have up to a third of their area available for planting.[56] Plants can also improve air quality indirectly through mitigating the urban heat island effect which stirs up dust particles found on the ground. The lower surface temperature caused by plants is the primary component of smog; however, vegetation does not always respond positively to pollution stress. Air pollution has a negative impact on plant metabolism. A reduction of photosynthetic capacity or even the appearance of chlorosis or necrosis can be observed in

52. E. R. Ballantyne, R. K. Hill, and J. W. Spencer, "Probit Analysis of Thermal Sensation Assessments," *Int J Biometeorol* 21, no. 1 (1977): 29-43.

53. R. Emmanuel, "Thermal Comfort Implications of Urbanization in a Warmhumid City: The Colombo Metropolitan Region (Cmu)," *Building and Environment*, no. 40 (2005): 1594.

54. B. Croxford, A Penn, and B Hillier, "Spatial Distribution of Urban Pollution: Civilizing Urban Traffic," *Science of the Total Environment* 190(1996): 3-9.

55. E. G. McpPherson et al., "Quantifying Urban Forest Structure, Function, and Value: The Chicago Urbanforest Climate Project," *Urban Ecosystems* 1(1997): 49-51.

56. W. J. Bealey et al., "Estimating the Reduction of Urban Pm10 Concentrations by Trees within an Environmental Information System for Planners," *J Environ Manage* 85, no. 1 (2007): 44-58.

plants, which are planted in a heavily polluted environment.[57] Consideration has also to be given to the species of vegetation since some species can emit volatile organic hydrocarbons (VOCs) that combine with oxides of nitrogen to form smog.[58]

Stormwater in the urban environment is traditionally routed off impervious surfaces and transported in drainage-pipe systems to purification plant and then, an adjacent receiving water body. It requires ample amount of energy to cleanse the water, and not only that, flooding may occur in conditions when the drainage system cannot store and subsequently evaporate large amounts of precipitation. Discharging stormwater is not an environmentally friendly solution, since it is associated with degraded aquatic ecosystems.[59] The ability of the planted surface to retain stormwater has often been cited as a practical technique for controlling runoff in a built environment. Environmentally, this translates into benefits such as reduction of surface contaminants in the rainwater, reduced occurrence of soil erosion and improved well-being for aquatic plants and animals. Mulching or covering the impervious surfaces with layers of plants and soil is an effective method of conserving water.[60] Small plants, such as sedum plants and mosses, are more suitable in this area, since they are able to live under extreme conditions with thin growing media and low water supply. A study carried out in Berlin showed that the runoff of a planted area near a railway was only 9% of precipitation while it was up to 70 to 80% of precipitation for an asphalt surface.[61] The technique can be applied not only at a group level but to impervious roofs. In Berlin, average water retention capacity was observed at 75% of precipitation with 1 m^2 planted modules on a rooftop.[62] During the 38th International Federation of Landscape Architects (IFLA)

57. M. D. Coleman et al., "Carbon Allocation and Partitioning in Aspen Clones Varying in Sensitivity to Tropospheric Ozone," *Tree Physiol* 15, no. 9 (1995): 585-92.

58. A. H. Rosenfeld et al., "Painting the Town White and Green," MIT Technology Review, http://eetd.lbl.gov/HeatIsland/PUBS/PAINTING/.

59. R. J. Miltner, D. White, and C. Yoder, "The Biotic Integrity of Streams in Urban and Suburbanizing Landscapes.," *Landscape and Urban Planning* 69(2004): 87-100.

60. John E. Adams, "Influence of Mulches on Runoff, Erosion and Soil Moisture Depletion.," *America Society of Soil Science Proceedings* 30(1966): 110-14.

61. F. O. T. Silva et al., "Ability of Plant-Based Surface Technology to Improve Urban Water Cycle and Mesoclimate.," *Urban Forestry and Urban Greening* 4(2006): 145-58.

62. H. Diestel, M. Kohler, and M. Schmidt, "Funktion Begrunter Dacher Im Stadtischen Raum," *Bundesbaublatt* 9(1993): 729-30.

World Congress Conference held in Singapore, a case study on the applicability of green roofs as a storm management system in the humid tropics revealed that a green roof allows a significant reduction of the peak load during stormwater events.[63] In this case, an annual retention rate of 65% can be expected. Several peculiarities of the tropics may affect the water retention potential of green roofs. First, frequent stormwater events may result in the potential erosion of newly implemented green roofs and the quicker saturation of the substrate. Secondly, high tropical temperatures may cause a higher evaporation rate and gain in biomass, which presumably increases the water retention rate.

Green plants are the earth's lungs.[64] Plant life can release oxygen to the atmosphere through its unique photosynthesis, which breaks down carbon dioxide and water to create sugars and oxygen. This achieves not only oxygen generation but also carbon dioxide absorption. For instance, one beech tree could produce enough oxygen for ten humans every hour.[65] Carbon emissions in cities can also be cancelled by trees which absorb carbon during the daytime. Meanwhile, plants have the capacity to store carbon in their tissues as they grow. CO_2 concentrations in urban areas can be 5 to 80 ppm above adjacent rural areas where extensive plants are growing.[66] However, both the decomposition of organic matter and the night-time respiration of plants would instead require the consumption of oxygen and the release of carbon dioxide. Plants in cities actually reduce carbon dioxide in an indirect manner rather than a direct one. The ability of vegetation to protect hard surfaces and lower temperature reduces the cooling energy required. It indirectly decreases the emission of carbon dioxide from power plants. The amount of carbon dioxide avoided via such indirect effects is considerably greater than

63. M. Kohler et al., "Urban Water Retention by Greened Roofs in Temperate and Tropical Climates.," in *Conference of the 38th IFLA World Congress* (Singapore2001).

64. Charles A. Lewis, *Green Nature/Human Nature : The Meaning of Plants in Our Lives*, The Environment and the Human Condition (Urbana: University of Illinois Press, 1996), 4-5.

65. G. Minke and G. Witter, "Haeuser Mit Gruenem Pelz, Ein Handbuch Zur Hausbegruenung," in *Verlag Dieter Fricke GmbH* (Frankfurt1982).

66. R. D. Berry and J. J. Colls, "Atmospheric Carbon Dioxide and Sulphur Dioxide on an Urban/Rural Transect-1. Continuous Measurements at the Transect Ends," *Atmospheric Environment* 24A(1990): 2681.

the amount sequestered directly.[67] It was estimated that the planting of urban trees and the use of light-colored surfaces can reduce the total carbon production in the United States by about 2%.[68]

Plants' root and the soil can remove some of the impurities in the water such as nitrogen or phosphorus, chemically bond with some types of soil particles, before they enter a groundwater aquifer. Subsequently, they are removed from the soil and taken up by plants. It is believed that the majority of cadmium, copper and lead as well as notable zinc and nitrogen levels can be taken out of the rainwater by plants.[69] For example, nitrate concentration was found to be significantly higher at a suburban site compared to a forested site.[70] The ability of a green roof to act as a natural filtration mechanism depends on the nature and depth of the layers that make up the system. On the other hand, a green roof can also be a possible source of contamination, especially when easily dissolvable fertilizers are used.[71]

Plants situated between a noise source and a receiver can help to reduce the noise level perceived by the receiver. Many researchers have investigated the extent to which vegetation could be used to achieve noise control.[72] Plants are not totally effective at all frequencies for noise reduction. They generally become transparent when noise is at frequencies lower than 1 kHz.[73] However, it is possible that tree belts are able to attenuate low frequencies more effectively if they are arranged in a lattice

---

67. H. Akbari, A. H. Rosenfeld, and H. Taha, "Summer Heat Islands, Urban Trees, and White Surfaces," *ASHRAE Proceedings* (1990).

68. H. Akbari, L. Gartland, and S. Konopacki, "Measured Energy Savings of Lightcolored Roofs: Results from Three California Demonstration Sites.," *Proceedings of the 1998 ACEEE Summer Study on Energy Efficiency in Buildings* (1998).

69. J. Johnston and J. Newton, "Building Green: A Guide for Using Plants on Roofs, Walls and Pavements," *The London Ecology Unit*(1996).

70. C. M. Aelion, J. N. Shaw, and M. Wahl, "Impact of Suburbanization on Ground Water Quality and Denitrification in Coastal Aquifer Sediments," *Journal of Experimental Marine Biology and Ecology* 213(1997): 31-51.

71. J. C. Berndtsson, T. Emilsson, and L. Bengtsson, "The Influence of Extensive Vegetated Roofs on Runoff Water Quality," *Sci Total Environ* 355, no. 1-3 (2006): 48-63.

72. R. Bullen and F. Fricke, "Sound Propagation through Vegetation," *Journal of Sound and Vibration*, no. 80 (1982): 11-23.

73. Ibid.

configuration.[74] Leaves and branches of the vegetation play an important role in reducing the noise level when it is at the middle frequency range. Tree belts normally take effect at high frequencies (>2 kHz) due to the absorption of sound by the foliage.[75] It has been found that noise reduction can be achieved within a distance of eight times the tree height.[76] Green roofs can also provide noise reduction and acoustical benefits which largely depend on the mass of the substrate layer and on existing sound leaks, such as skylights.[77] In a study, green roofs showed their ability to reduce the noise level by up to 50dB.[78]

74. R. Martinez-Sara et al., "Control of Noise by Trees Arranged Like Sonic Crystals," *Journal of Sound and Vibration*, no. 291 (2006): 100-06.

75. F. Fricke, "Sound Attenuation in Forest," *Journal of Sound and Vibration*, no. 92 (1984): 149-50.

76. F. F. Chih and L. L. Der, "Guidance for Noise Reduction Provided by Tree Belts," *Landscape and Urban Planning*, no. 71 (2005): 31.

77. Nico A. Hendriks, "Designing Green Roof Systems: A Growing Interest," *Professional Roofing* September, 1994, 20-21.

78. McPherson E. Gregory, "Green Roofs: Not Your Garden-Variety Amenity," *Facilities Design & management*, no. 16 (10) (1994): 32.

3.1.2 Psychological Impacts

It has been proven that visual and physical contact with plants can result in direct health benefits. There are psychological effects of plants on humans, and plants can generate restorative effects leading to decreased stress, improve patient recovery rates and higher resistance to illness.[79] One way to explore landscape references is to show people slides, carefully controlled for content, ranging from totally urban to untouched wilderness settings. As the slides flash briefly on the screen, viewers are asked to indicate the attractiveness of each scene on a scale of one to five. Researchers quickly found that urban scenes lacking trees, shrubs, or grass receive uniformly low ratings, whereas the mere presence of vegetation enhances the appeal of a slide.[80] Despite the fact that humans have created massive technological landscapes, many cross-cultural studies show that we instinctively crave natural features in our surroundings.[81] Also, other research showed that residents having a balcony or terrace garden are less susceptible to illness in a high-density environment.[82] Dr. Howard A. Rusk gave some explanations as to why horticulture therapy can be successful:

Some patients are difficult to reach and motivate. Working with plants may provide an impetus and initiate a response… One of the great advantages of gardening is that it is not a static activity. There is always something happening – a new sprout, shoot, or leaf is forming, a flower is opening or fading and has to be removed. Then the cycle begins all over again. Most important […] is a living thing depending on them for care and sustenance. This gives the patient the will to go on and an interest in the future.[83]

---

79. R.S. Ulrich and R. Parsons, "Influences of Passive Experiences with Plants on Individual Well-Being and Helth," in *The Role of Horticulture in Human Well-being and Social Development: A National Symposium* (Arlington, Virginia, Portland: Timber Press Inc., 1992).

80. Roger Ulrich, "Natural Versus Urban Scenes: Some Psychophysiological Effects," *Environment and Behavior* 13(1981): 523-66.

81. Lewis, *Green Nature/Human Nature : The Meaning of Plants in Our Lives*, 13-15.

82. J. Johnston and J. Newton, *Building Green: A Guide for Using Plants on Roofs, Walls and Pavements*. (London: The London Ecology Unit, 1996).

83. Carol Venolia and Debra L. Dadd, *Healing Environments: Your Guide to Indoor Well-Being* (Celestial Arts, 1995).

Also, natural settings are essential for healthy child development because they stimulate all the human senses and integrate informal play with formal learning.[84] According to Moore, multisensory experiences in nature help to build "the cognitive constructs necessary for sustained intellectual development," and stimulate imagination by supplying the child with the free space and materials for what he calls children's "architecture and artifacts." "Natural spaces and materials stimulate children's limitless imaginations and serve as the medium of inventiveness and creativity observable in almost any group of children playing in a natural setting."[85] Researchers have also observed that when children played in an environment dominated by play structures rather than natural elements, they established their social hierarchy through physical competence; after an open grassy area was planted with shrubs, the quality of play in what the study termed "vegetative rooms" was very different. Children used more fantasy play, and their social standing became based less on physical abilities and more on language skills, creativity, and inventiveness.[86]

Other 'sensory dimensions' of vegetation can also lead to health improvement. The 'white noise' similar to the sound of wind rustling through leaves has been used in hospital wards to mask disturbing sounds and help heart attack victims to relax.[87] The fragrances of flowers and plants can trigger responses that are more cognitive, and tend to be remembered more vividly than visual stimuli.[88]

Additionally, in the office situations, many people feel that adding plants to interior spaces improves worker productivity and satisfaction, and there are concrete study examining these impacts. The researches of office worker productivities have been done for long periods of time. Accounts of studies conducted in Germany in the 1960s

---

84. Robin C. Moore and Herb H. Hong, "Natural Spaces and Materials Stimulate Children's Limitless Imaginations," in *Natural Learning: Creating Environments for Rediscovering Natrue's Way of Teaching* (Berkeley, CA: MIG Communications, 1997).

85. Ibid.

86. Richard Louv, *Last Child in the Woods : Saving Our Children from Nature-Deficit Disorder*, 1st ed. (Chapel Hill, NC: Algonquin Books of Chapel Hill, 2005), 87.

87. J. F. Dwyer, Schroeder, H. W. and Gobster, P. H., *The Deep Significance of Urban Trees and Forests*, The Ecological City: Preserving and Restoring Urban Biodiversity (Massachusetts: University of Massachusetts Press, 1994), 137-39.

88. J. Douglas Porteous, "Smellscape," *Progress in Human Geography* 9(3)(1985): 356-78.

assert that improved employee morale, decreased absenteeism, and increased worker efficiency result when plants are added to offices spaces compared to traditional, unplanted offices.[89] [90] In the same era, the open - plan 'office landscape,' characterized by the abundant use of large potted plants to separate work spaces, was popular.[91] In the 1980s, reviews of the merits of interior landscaping continued to suggest that plants boost employee productivity, even by as much as 10% to 15%, when incorporated in offices and other work areas.[92] [93] These reports of increased worker productivity in indoor landscaped offices and work areas have been common. Although the office environment has changed over time, interior plants continue to be used in work spaces. As jobs become more technologically complex, the frequency of stress - related disorders in work environments increases.[94] The need for a thorough understanding of the relationship between plants and human well - being is increasingly important.[95]

Interaction with plants, both passive and active, can change human attitudes, behaviors, and physiological responses.[96] The stress - reducing benefits of passively viewing plants in natural settings are well documented (see Figure 3);[97] [98] however, many workers labor in windowless office spaces with few opportunities to view nature. Research indicates that workers in such windowless environments have lower job

---

89. Everett Conklin, "Interior Plants Bring Nature Indoors," 139(2):12-13(1974): 105-12.

90. ——, "Interiorlandscaping. 1," *Arboriculture 4* (1978): 73-79.

91. E. Sundrom, *Work Places: The Psychology of the Physical Environment in Offices and Factories* (New York: Cambridge University Press, 1986).

92. B. Marchant, "A Look at the Industry-Dimensions and Prospects," *Amer. Nurseryman* 156(10)(1982).

93. Scrivens. S, *Interior Planting in Large Buildings* (London: The ArchitecturalPress, 1980).

94. A.S. Sethi, D.H.J. Caro, and R.S. Schuler, Strategic Management Off Technostress in an Information Society (Lewiston, NY: C.J. Hogrefe. Inc., 1987), 383-86.

95. D. Relf, "Psychological and Sociological Response to Plants: Implications Forhorticulture," Hort Schience 25 (1990).

96. Ibid.

97. Honeyman. M.K., The Role of Horticulture in Human Well-Being and Social Development: A National Symposium (Portlan, OR: Timber Press, 1992).

98. Moore. E.O., "A Prison Environment's Effect on Health Care Service Demands," J. Environmental Systems II (1981): 17-34.

satisfaction and rate the physical conditions of their work as less 'pleasant and stimulating' than people in windowed settings.[99] Plants are widely used to personalize and decorate offices, and they are important in improving satisfaction with indoor space.[100] [101]

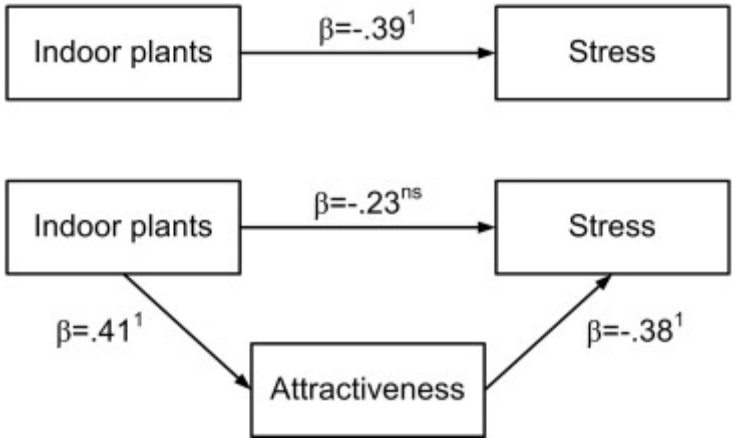


Figure 35 Mediation Model by Indoor Plants (Data from an experiment conducted from March to May 2007 in the Netherlands)

There are also number of researches that proves the relativeness between vegetation and crime. There is a long tradition of addressing crime in problem areas by removing vegetation. As early as 1285, the English King Edward I sought to reduce highway robbery by forcing property owners to clear highway edges of trees and shrubs.[102] Today, that tradition continues as park authorities, universities, and municipalities across North America engage in active programs to remove vegetation because it is thought to conceal and facilitate criminal acts.[103] As a rule, the belief is that

---

99. Mary C. Finnegan and Linda Zener Solomon, "Work Attitudes in Windowed Vs. Windowless Environments," *The Journal of Social Psychology* 115, no. 2 (1981): 291-92.

100. R. H. Manson, Laviana I.E., and EH. Rohles, Plants as Enhancers of the Indoor Environment (Santa Monica1983).

101. K. Randall, P.D. Relf, and E.S. Geller Shoemaker, "Relationships between Plants, Behavior, and Attitudes in an Office Environment," Hort Technology 2 (1992): 205-06.

102. Pluncknett T.F.T., *Edward I and Criminal Law* (Cambridge, UK1960).

103. S.N. Michael, R.B. Hull, and D.L. Zahm, "Environmental Factors Influencing Auto Burglary: A Case Study," (1999).

vegetation facilitates crime because it hides perpetrators and criminal activity from view. Although no studies to date have examined whether crime rates are actually higher in the presence of dense vegetation, a variety of evidence links dense vegetation with fear, fear of crime, and possibly crime itself. It is certainly the case that many people fear densely vegetated areas. In research on urban parks, densely wooded areas have consistently been associated with fear. In one study, safety ratings for 180 scenes of urban parks showed that individuals felt most vulnerable in densely forested areas and safest in open, mowed areas.[104] And in another study, individuals who were asked for their open-ended responses to photo graphs of urban parks indicated that heavily vegetated areas seemed dangerous.[105] Although neither of these studies specifically probed fear of crime (as opposed to more general fear), it was clear that at least some participants had crime in mind; one respondent specifically suggested that weedy areas gave muggers good hiding places.[106]

However, not all vegetation blocks views. A well-maintained grassy area certainly does not block views; widely spaced, high-canopy trees have minimal effect on visibility; and flowers and low-growing shrubs seem unlikely to provide cover for criminal activities. I suggest that although the rule that vegetation aids crime may hold for visibility-decreasing forms of vegetation, there are systematic exceptions to this rule.

Moreover, recent study proves that vegetation has been positively linked to fear of crime and crime in a number of settings. Residents living in "greener" surroundings report lower levels of fear, fewer incivilities, and less aggressive and violent behavior.[107] Another mechanism by which vegetation might inhibit crime is through mitigating mental fatigue. S. Kaplan suggested that one of the costs of mental fatigue may be a heightened propensity for "outbursts of anger and potentially […] violence", and three proposed symptoms of mental fatigue—irritability, inattentiveness, and decreased control

---

104. Herbert W. Schroeder and L. M. Anderson, "Perception of Personal Safety in Urban Recreation Sites," *Journal of Leisure Research* 16, no. 2 (1984): 178-94.

105. Janet Frey Talbot and Rachel Kaplan, "Needs and Fears: The Response to Trees and Nature in the Inner City," *Journal of Arboriculture* 10, no. 8 (1984): 222-28.

106. Ibid.

107. Frances Kuo and William Sullivan, "Environment and Crime in the Inner City - Does Vegetation Reduce Crime?," *Environment and Behavior* Vol. 33, no. 3 (2001): 343-67.

over impulses—are each well-established psychological precursors to violence. Irritability is linked with aggression in numerous studies.[108] Inattentiveness has been closely tied to aggression in both children[109] and adolescents.[110] In addition, impulsivity is associated with aggression and violence in a variety of populations.

As I mentioned earlier, vegetation aids in the recovery from mental fatigue. Contact with nature in a variety of forms is systematically linked with enhanced cognitive functioning as measured by both self-report and performance on objective tests.[111] Irritability, inattentiveness, and impulsivity are symptoms of mental fatigue, and as first proposed in S. Kaplan and recently elucidated in Kuo and Sullivan, reductions of mental fatigue helps to decrease violent behavior.

I propose that vegetation can deter crime in urban neighborhoods in any or all of the following ways: by increasing residents' informal surveillance of neighborhood spaces, by increasing the implied surveillance of these spaces, and by mitigating residents' mental fatigue, thereby reducing the potential for violence.

---

108. Gian V. Caprara and Paolo Renzi, "The Frustration-Aggression Hypothesis Vs. Irritability.," *Recherches de Psychologie Sociale*, no. 3 (1981): 75-80.

109. M. A. Stewart, "Aggressive Conduct Disorder: A Brief Review.," *Aggressive Behavior* 11(1985): 323-31.

110. R.H.J. Scholte, M.A.G. van Aken, and C.F.M. van Leishout, "Adolescent Personality Factors in Self-Ratings and Peer Nominations and Their Prediction of Peer Acceptance and Peer Rejection.," *Journal of Personality Assessment* 69, no. 534-554 (1997).

111. L. H. Canin, "Psychological Restoration among Aids Caregivers: Maintaining Self-Care." (University of Michigan, 1991).

3.2 Policy

3.2.1 Current Policy and Issues in Japan

The Japanese government has indicated serious interest in joining the ongoing negotiations of nine countries in the Trans-Pacific Partnership (TPP), including the U.S. and Australia, to draft a high quality free trade agreement (FTA). The Japanese government has avoided discussions on FTA with countries with agricultural export industries because of its highly protected agriculture. If Japan is to reach an agreement, major changes will be required in Japanese agricultural policies and exporting countries may also have to adjust their expectations.

The Organization for Economic Cooperation and Development (OECD) estimates for 2010 the Japanese government subsidized 49 percent of the farm value of production, more than twice the average of 18 percent for all OECD countries.[112] For comparison, the EU was at 22 percent, the U.S. 9 percent and Australia 3 percent.[113] Most of Japanese agriculture is protected by tariffs and production subsidies.

Despite import protections and subsidies, on a calories-consumed basis, Japan annually imports 60 percent of its food, valued at $50 billion per year, and is the world's third largest importer after the U.S. and the EU. Imports from the U.S. were $11.8 billion in 2010, the fourth largest market for the U.S., and including transportation costs totaled $14 billion, over 25 percent of Japanese food imports.[114]

On a value basis, Japan is the world's largest meat importer, accounting for about 20 percent of its total agricultural imports. Japan has an import tariff of only 4.3 percent for fresh, chilled and frozen pork; 8.5 percent for offal and salted, dried and smoked products; 10 percent for sausages and 21.3 percent for other products.[115] A "gate

112. OECD, "Agricultural Policies in Oecd Countries,"(2010), http://www.oecd.org/dataoecd/37/16/43239979.pdf.

113. Ibid.

114. Food and Agriculture Organization of the United Nations, "Import and Export Values of Agricultural Products of Major Countries," (Food and Agriculture Organization of the United Nations, 2007).

115. United States Department of Agriculture, "Production, Supply and Distribution Database," (United States Department of Agriculture, 2008).

price system" (negotiated in the WTO Uruguay Round) imposes a minimum price on pork imports that limits imports and holds Japanese hog prices at roughly twice the U.S. price. Beef imports have a tariff of 38.5 percent, but U.S. beef must come from cattle 20 months of age or younger because of concerns about BSE. The U.S. and the Japanese government are in talks about increasing this to 30 months.

Japan is the world's largest net importer of dairy products, but has large domestic production heavily managed by government policies. Dairy products without tariff rate quotas (TRQ) generally have tariffs of 20-40 percent. Most dairy products are subject to TRQ, including one multi-product TRQ reserved for a state trading enterprise, the Agriculture and Livestock Industries Corporation (ALIC). Over-quota tariffs are equivalent to 50-500 percent.[116]

Except for rice, imports provide 85 percent to almost 100 percent of the supply of food grains and feed grains.[117] Wheat and barley have TRQs, but only the Food Department of the Ministry of Agriculture, Food and Fisheries (MAFF) has the right to import under the TRQs and may add a markup on resale. Japan is required to have minimum TRQs under WTO agreements, but MAFF surveys users to determine needs and imports adequate amounts. Tariffs for whole grain wheat and barley are zero, while processed products have a 25 percent tariff.[118] Over quota tariffs are in monetary terms, not percentage, and are large enough to prevent imports.

Rice is the only product that the Japanese government offers monetary compensation to the farmers in order to suppress over production by diverting paddy land to other crops. Under WTO rules, Japan is required to import 682,000 metric tons of rice and products per year under a TRQ, and MAFF has the sole authority to purchase imported rice.[119] Over-quota rice can be imported privately, but it has a tariff of $2,800 per ton.[120]

---

116. Ministry of Finance, "Trade Statistics of Japan," (Ministry of Finance Japan, 2010).

117. Ibid.

118. Ibid.

119. "Principles of the Environmental Policy in Agriculture, Forestry and Fisheries," ed. Forestry and Fisheries Ministry of Agriculture (Tokyo, Japan2011).

120. Finance, "Trade Statistics of Japan."

The tariff on soybeans and other oilseeds, except peanuts, is permanently bound at zero. Crude and refined soybean oils have tariffs of about $100 per ton to protect the processing industry.[121] Tariffs on imported soy-based foods include 7.2 percent on soy sauce and 10.6 percent on tofu.[122]

According to ERS estimates, fruit in Japan was a $10 billion wholesale market in 2009, with $450 million coming from the U.S., 10 percent of U.S. fruit exports.[123] Most fresh products have tariffs of 10-20 percent with frozen products at 12 percent.[124] Some higher seasonal tariffs also apply. Sanitary and phytosanitary (SPS) issues are significant for many fruit products.

What happens if Japan agreed to contract TPP? TPP would in principle eliminate all tariffs within the zone, including on farm products, which have largely been excluded from Japan's previous free trade deals. Joining the free trade initiative would help Japan's auto and high-tech exporters compete in the global market, but would deal a blow to its well-protected farming sector by opening the door to cheaper overseas farm products. The domestic product prices will have to decrease and most of the farmers in Japan will not be able to earn enough money to support them, and as a result, the food independency rate will suffer even more.

I believe there are extremely critical issues, and now is the best time more than ever to reconsider the agricultural practice in Japan. The issues of farm industry in Japan are very complex. "The increasing in aging population of Japan's farm industry is serious problem. If the situation continues, there will probably be no farmers left in Japan within 10 years. If no reform is taken, and the industry cannot attract the young generations, the farm sector will soon be abandoned," Hisashi Yamada, chief economist of the Japan Research Institute, said in an interview.[125]

---

121. Ibid.

122. Ibid.

123. Kenzo Ito and John Dyck, "Fruit Policies in Japan," ed. United States Department of Agriculture (2010).

124. Finance, "Trade Statistics of Japan."

125. Xinhua, "Japan Likely to Join Tpp Talks Despite Worries on Farm Sector," People's Daily Online, http://english.peopledaily.com.cn/102774/7640934.html.

Japan's farm products do have some competitive strength in the global market because of its high quality, and I believe that the key to Japan's success in revitalizing farm sector lies in whether Japan will join the TPP and the government can soon make clear strategies to reform the existing system. I think that prices of farm products are too low for country like Japan considering the cost of living. Thus, I am proposing to create a system that enables people to farm on the side as a second job or as a hobby. In order to do so, the agricultural fields must be accessible and closer to where most of the people live: urban environment.

3.2.2 Proposed Policy

In order to encourage people to pursue agriculture in an urban situation, new policies have to be developed. Some people especially in Tokyo are highly concerned with environmental issues that there is an incentive policy about the green roofs already. In 1999, a low interest finance program commenced at national level, leading up to 40% of the total building construction cost if more than half of the roof area is being greened. The national government of Japan also introduced a five-year property tax cut program for buildings located in designated 'intensive greening zones' that achieve more than 20% of the site area in roof, wall and ground greening.[126] And in Tokyo, the heat island capital of the world in terms of research and empirical evidence, in 2001 the metropolitan government began to require that one-fifth of rooftop areas be greened, in addition to the 20% green area already required to be plant-covered. A development bonus is now granted if at least 30% of a rooftop is covered by grass, sedum, trees or other plants - except for moss.[127] This recent regulation seems very reasonable and beneficial. The policy that I am proposing is the amendment of this existing law in Tokyo.

In order to make developers eager to provide more green area, the metropolitan government in Tokyo decided to require 45% of rooftop areas to be greened. If there are 10% more green areas, it will gain a five-year property tax cut according to the green coverage rate. These policies are laid under the building code that whenever the architects submit for the building permit, the government plan-checker will examine to

126. Peter Droege, *The Renewable City : A Comprehensive Guide to an Urban Revolution* (Chichester, England ; Hoboken, NJ: Wiley-Academy, 2006), 148-49.

127. H. Akagawa, "Photovoltaic Capacity of Greater Sydney Roof Scapes.," (University of Sydney and Obayashi Technical Research Institute, 2002).

see whether it meets the requirement or not. What I am proposing is the amendment of this existing building code. Instead of defining green area only in broad meanings, cultivable green area should receive better incentive considering all of the benefit we will obtain from them. However, there is no similar precedent in the world, so the level and impact of the benefit and will be measured along the way. If the cultivable green area has measured more beneficial than uncultivable land, the incentive will be raised. I believe that the cultivable area could be evaluated as twice the value of uncultivable ones, which means if 30% of the rooftop areas were covered by agricultural field, it equals to 60% of the areas covered by uncultivable green areas. These numbers should be carefully examined and adapt to changes in circumstances. Since agricultural fields require more effort to maintain, and applicable roof forms and structures are restricted, it seems unfavorable to limit the incentive policy only to the cultivable areas. The benefit of reducing stormwater and heat island effect is nonnegligible that the incentive policy should include both cultivable and uncultivable green areas.

The ultimate goal is to have roofscape to be alike Stuttgart, Germany (Figure 36). Green roofs sprout toward the horizon in Stuttgart, Germany, where since 1989 municipal regulations have required all new, flat-roof buildings to have them.[128] Steven W. Peck, founder of the Canada-based industry association Green Roofs for Healthy Cities, says "all you have to do is climb a tall building in Germany, and you're going to see green roofs all over the place."[129]

128. National Geographic Society, "Up on the Roof," National Geographic(2011), http://ngm.nationalgeographic.com/2009/05/green-roofs/cook-photography.

129. Ibid.

Figure 36 Up on the Roof

(Source: National Geographic. Photograph by Diane Cook and Len Jenshel)

There are many manufactures that provide green rooftop nowadays that it is becoming inexpensive to specify them for new construction projects. However, there are various restrictions in order to install greenery on rooftop. The roof has to be flat with no or minimum obstacles, must be waterproofed, must have structural allowance for extra load, must be accessible and must be shade-free. These are not easy requirements to be satisfied especially for existing buildings. The strict conditions tend to limit the number of constructions that participate in more green roof installation and receive tax incentives.

In order to qualify for more tax incentive opportunities, other agricultural methodologies could be applied. In urban situations, agricultural fields could be divided into five; such as flat grounds, balconies, windows, walls and various indoor placements. Any of these agriculture fields have enough benefits for the environment and communities, and so, it still seems reasonable for other applicable fields other than rooftop to qualify for some or part of the tax incentive. It is true that the other fields are not as efficient or beneficial as rooftop agriculture as mentioned in the previous chapter, Chapter 3.1.1 Physical Impacts to Environment. They do not reduce heat island effect or irradiance for example; however, they can still improve the food independence issues, and I believe a partial incentive should be taken into consideration.

The example of tax incentive is shown on the Figure 37. If the floor area of the building is 10,000 square feet, 4,500 square feet of roof area is required to be green roof and if it has more than 5,500 square feet, it will gain property tax cut. It will only need 2,250 square feet of roof area if the green roof is cultivable, and gain property tax cut if 2,750 square feet of roof area is cultivable. If the roof cannot have green roof, the building requires 9,000 square feet of agricultural field at flat grounds, balconies, windows, walls and/or various indoor placements, and 11,000 square feet for incentive.

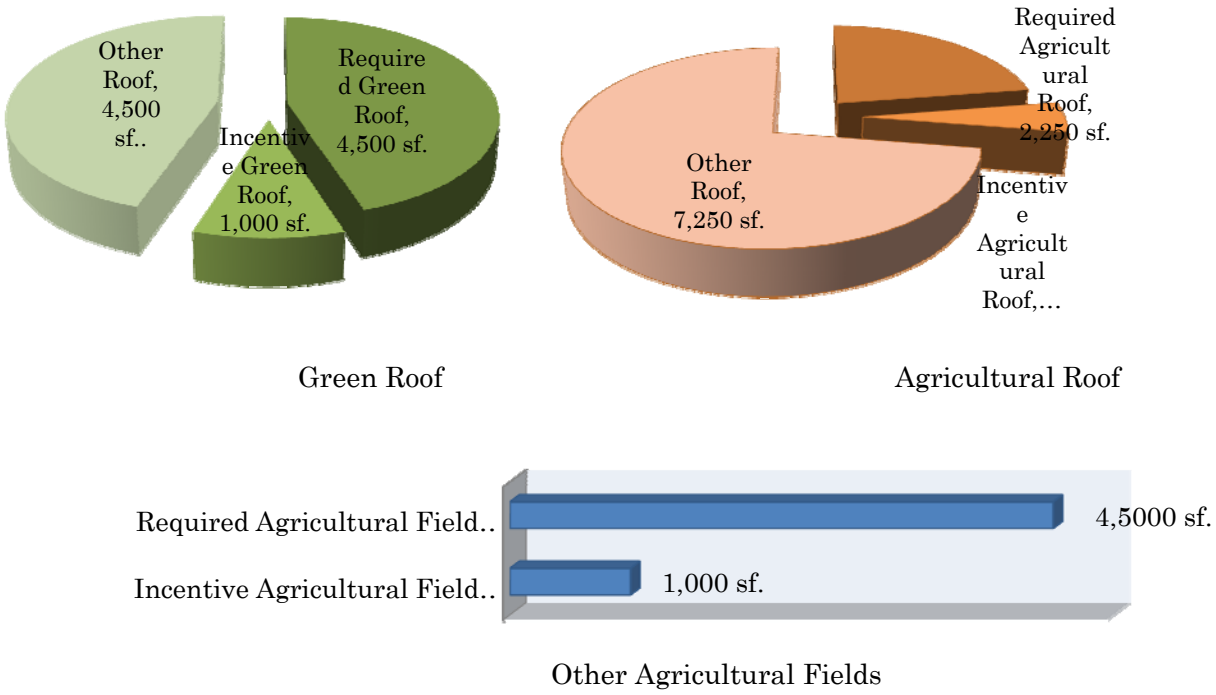


Figure 37 Required Green Area and Agricultural Field, Prepared by Takao Ugai

The base of this policy has been in force at Tokyo, and my proposal is to favor and encourage the active use of the agricultural field more than simple green field. Since there are no precedents available now, all of these figures must be examined very carefully and amended by adapting the further research results. However, basic idea is to give the people more incentive in order to encourage them to pursue agricultural practices in an urban situation.

3.3 Urban Agriculture Methodologies

The agricultural methodologies could be divided into four types: conventional, hydroponic, aeroponic, and aquaponic farming. In order to integrate agriculture into urban architectures, architects require basic knowledge of the systems, benefits and visual appearance of each system.

3.3.1 Conventional Farming

In an urban environment, polyculture is more favorable than monoculture. Polyculture is a type of agriculture which cultivates multiple crops in the same space, in imitation of the diversity of natural ecosystems, avoiding large stands of single crops or monoculture. It includes crop rotation, multi - cropping, intercropping, companion planting (see Appendix B: Plant List for details) beneficial weeds, and alley cropping. The diversity of crops avoids the susceptibility of monocultures to disease. For example, a study in China reported in Nature showed that planting several varieties of rice in the same field increased yields by 89%, largely because of a dramatic (94%) decrease in the incidence of disease, which made pesticides redundant.[130] The greater variety of crops provides habitat for more species, increasing local biodiversity. Furthermore, it will be more visually appealing with multiple colors and shapes.

Figure 38 Polyculture (Photo by Jersey Shore)

130."Genetic Diversity and Disease Control in Rice," *Nature 406*: 718-22.

3.3.2 Hydroponic Farming

Hydroponics is a subset of hydro-culture and a method of growing plants in water, using mineral nutrient solutions instead of conventional soil. Terrestrial plants may be grown with their roots soaked in the mineral nutrient solution only or in an inert medium, such as perlite, gravel, or mineral wool. See Figure 39 for basic diagram of hydroponic system.

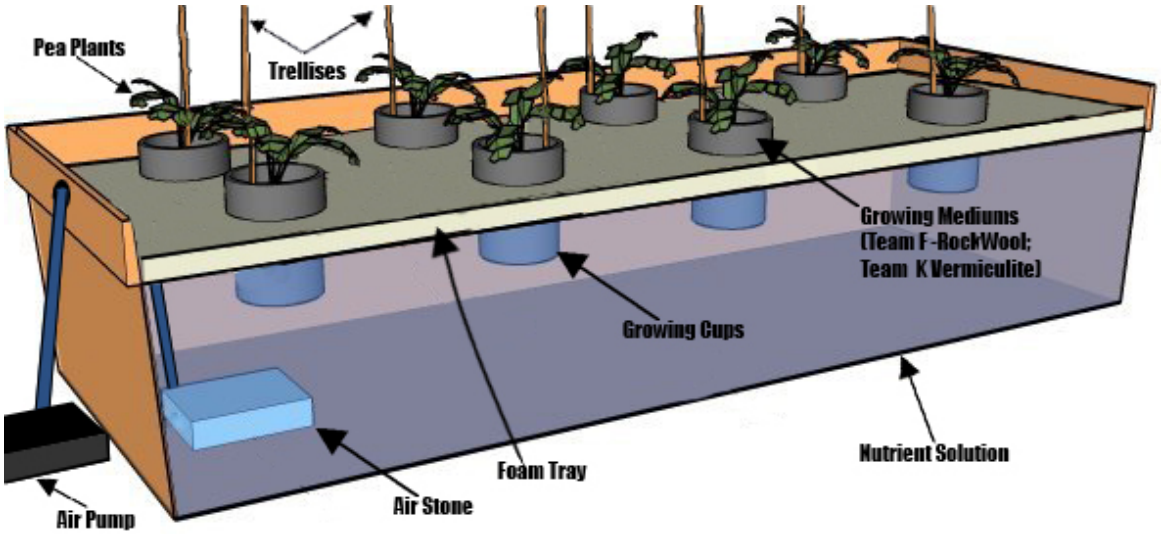


Figure 39 Basic Diagram of Hydroponic System (Diagram drawn by Bryce Harlan)

Researchers discovered in the 18th century that plants absorb essential mineral nutrients as inorganic ions in water.[131] In natural conditions, soil acts as a mineral nutrient reservoir but the soil itself is not essential to plant growth. When the mineral nutrients in the soil dissolve in water, plant roots are able to absorb them. When the required mineral nutrients are introduced into a plant's water supply artificially, soil is no longer required for the plant to thrive. Almost any terrestrial plant will grow with hydroponics.

The principle advantages of hydroponic farming include high-density maximum crop yield, crop production where no suitable soil exists, a virtual indifference to ambient temperature and seasonality, more efficient use of water and fertilizers, minimal use of

131. Douglas and James S., "Hydroponics," Bombay, No. 5th Ed. (1975): 1-3.

land area, and suitability for mechanization and disease control.[132] A major advantage of hydroponics, compared to growth of plants in soil, is the isolation of the crop from the underlying soil, which often has problems of disease, salinity, poor structure and draining.[133] The costly and time-consuming tasks of soil sterilization and cultivation are unnecessary in hydroponic systems and a rapid turnaround of crops is readily achieved.

Since there is no soil involved in hydroponic farming, the visual appearance of the field is very clean and simple. The construction involves minimal mechanical system and easily constructible. There are some of the creative designs performed by the architects (Figure 40).

Figure 40 Hydroponic Farming

(Photo by Easy to Make Homemade Aeroponics Systems (left) and Eco Village (right))

132. Merle H. Jensen, "Hydroponics Worldwide - a Technical Overview," (Tucson, Arizona: University of Arizona, 2002), 1-3.

133. Ibid.

3.3.3 Aeroponic Farming

Aeroponic farming is the process of growing plants in an air or mist environment without the use of soil or an aggregated medium. The basic principle of aeroponic growing is to grow plants suspended in a closed or semi-closed environment by spraying the plants' dangling roots and lower stems with an atomized or sprayed, nutrient-rich water solution (Figure 41).[134] Leaves and crowns, often called the "canopy", extend above the roots. The roots of the plants are separated by the plant support structure. Many times closed cell foam is compressed around the lower stem and inserted into an opening in the aeroponic chamber, which decreases labor and expense; for larger plants, trellising is used to suspend the weight of vegetation and fruit.

Ideally, the environment is kept free from pests and diseases so that the plants may grow healthier and more quickly than plants grown in a medium. Although, most aeroponic environments are not perfectly sealed, and pests and diseases may still become a threat, controlled environments advance plant development, health, growth, flowering and fruiting for any given plant species and cultivars.

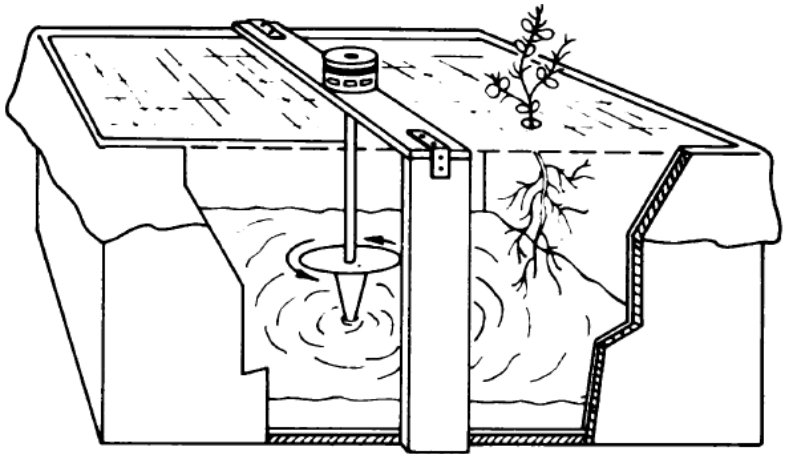


Figure 41 Diagrammatic Cut - Away View of Aeroponic System[135]

134. Katie Murphy, "Farm Grows Hydroponic Lettuce," *The Observer* (2006).

135. Rechard W. Zobel, Peter Del Tredici, and John G. Torrey, *Method for Growing Plants Aeroponically 1* (Petersham, Massachusetts: Cabot Foundation, Harvard University, 1975).

Aeroponic system is considered to be safe and ecologically friendly for producing natural and healthy plants and crops. The main ecological advantages of aeroponic are the conservation of water and energy. When compared to hydroponic, aeroponic offers lower water and energy inputs per square meter of growing area. When used commercially, aeroponic uses one - tenth of the water otherwise necessary to grow the crop.[136]

Unlike hydroponic system, aeroponic system does not require plants to submerge in the water. This feature enables the architects to design three-dimensional farming field that are stacked vertically or even more complicated shapes (Figure 42).

Figure 42 Aeroponic farming (Photo by Tim Blank)

136. Steven M. Schorr and Richard J. Stoner Jr., "Method and Apparatus for Aeroponic Propagation of Plants," (United States: Genisis Technology, Inc., 1985).

3.3.4 Aquaponic Farming

Aquaponic farming is a sustainable food production system that combines a traditional aquaculture (raising aquatic animals such as snails, fish, crayfish or prawns in tanks) with hydroponics (cultivating plants in water) in a symbiotic environment.[137] In the aquaculture, effluents accumulate in the water, increasing toxicity for the fish. This water is led to a hydroponic system where the by - products from the aquaculture are filtered out by the plants as vital nutrients, after which the cleansed water is re-circulated back to the animals (Figure 43).

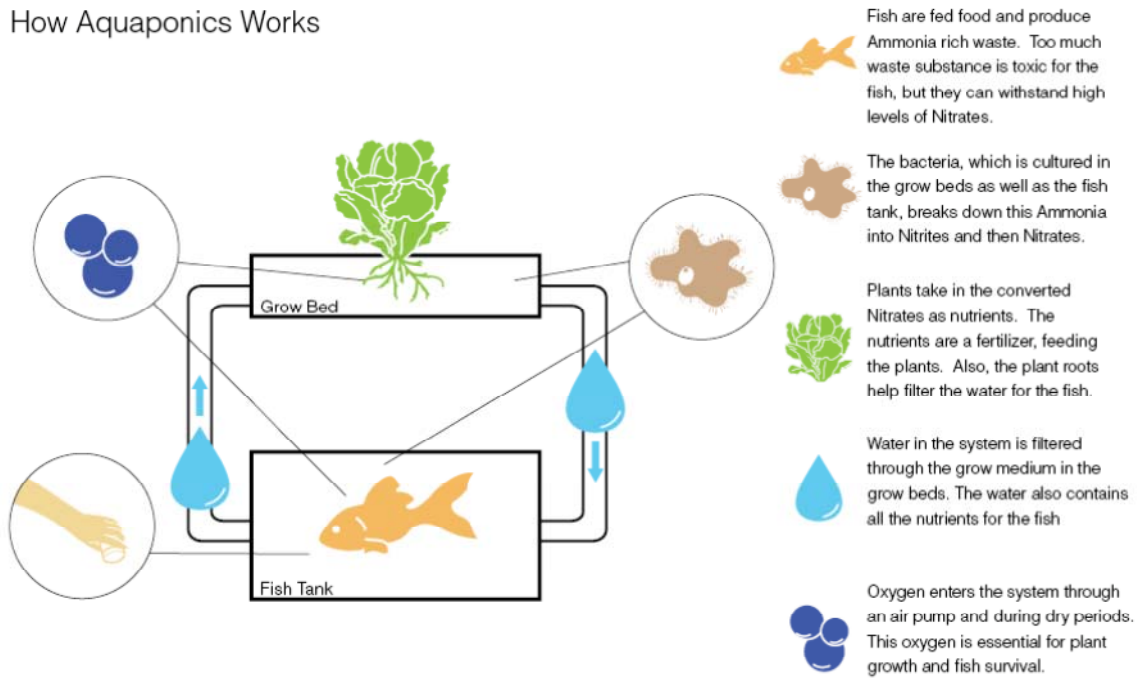


Figure 43 Basic Diagram of Aquaponic System (Diagram by Reynolds Thomas)

Aquaponic systems do not typically discharge or exchange water under normal operation, but instead recirculate and reuse water very efficiently. The system relies on the relationship between the animals and the plants to maintain a stable aquatic environment that experience a minimum fluctuation in ambient nutrient and oxygen levels. Water is only added to compensate for any loss from absorption and transpiration

137. Jim Hollyer et al, "On-Farm Food Safety: Aquaponics," (Honolulu, Hawaii: College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, 2009).

by plants, evaporation into the air from surface water, overflow from the system from rainfall, and removal of biomass such as settled solid wastes from the system.

Although the practices of fish farming and hydroponic farming have been traced to ancient times, the combination of the two is rather new, and there are very few commercial aquaponic operations. It is mainly due to the delicate ratio between growing plants and fishes. The scientists at the University of the Virgin Islands have determined that for each 60 - 100 grams of fish food added per day, you can support 1 sq. meter of plants in raft aquaponics.[138] As long as the users follow these numbers, aquaponic farming could be conducted in various scales. See Figure 44 for commercial scale aquaponic and Figure 45 for small scale aquaponic.

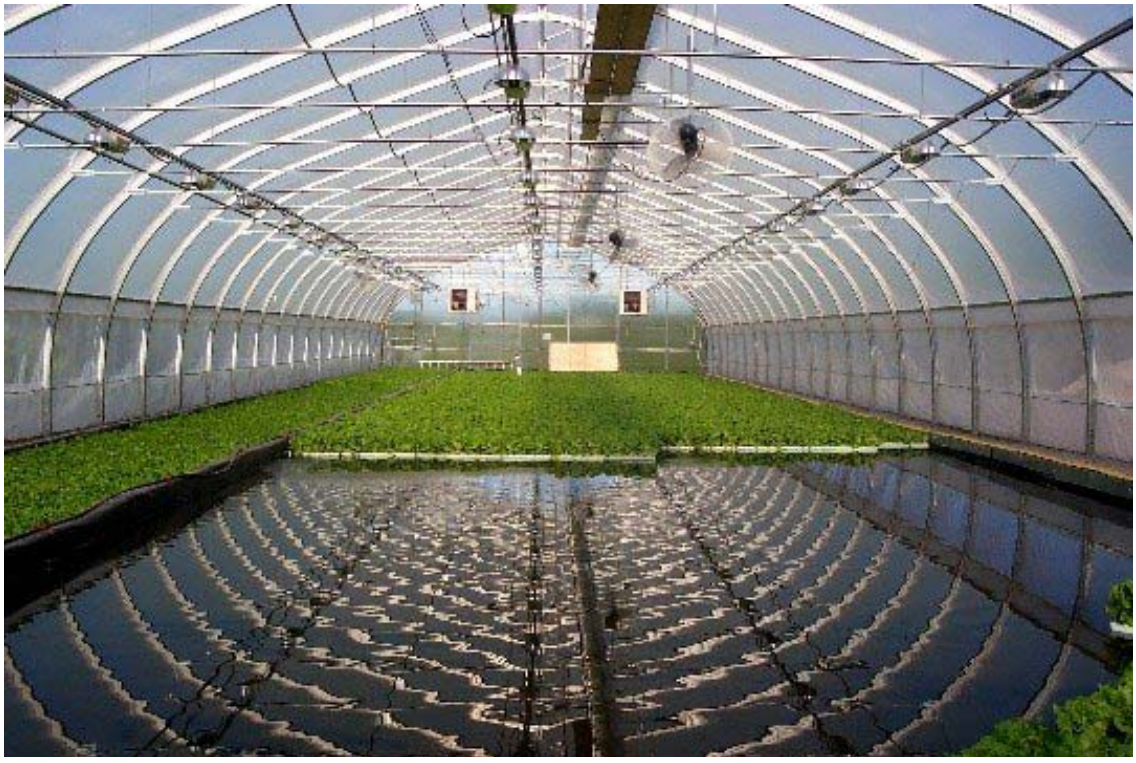


Figure 44 Commercial scale aquaponic (Photo by Local Philosophy)

138."Aquaponic Technology, Systems and Supplies," 18 Nelson and Pade Inc., https://aquaponics.com/.

Figure 45 Small Scale Aquaponic - The “Floating Garden” (Photo by Benjamin Graindorge)

4. Urban Agricultural Practices

In urban situations, agricultural fields could be located at six settings; such as grounds, rooftops, balconies, windows, walls and various indoor placements. This chapter focuses on each field in terms of architectural components. It discusses how these agricultural platforms can benefit the people, urban and spaces, and how efficiently agricultural methodologies can be implemented in various situations in urban areas.

4.1 Ground Farming

For the flat ground farming, architects and landscape architects must take physical appearance into consideration when selecting plants. Vegetation can provide visual contrast and relief from the highly built-up city environment.[139] Plants also give urban dwellers a significant psychological sense of connection with Mother Nature in concrete jungles where buildings and pavements dominate the landscape. Also, vegetation provides elements of natural scale, visual beauty, and also functions as seasonal indicator. Some of the emotional and psychological benefits of plants are not easy to be evaluated quantitatively; however, incorporating plants around buildings can offer visual interest and relief to plain walls and roofs and separate them from the obtrusive hard edges of surrounding buildings. Their height, color, scent, seasonal changes and sizes will drastically impact the quality of open spaces (Figure 46). The visual appeal from above is an equally important benefit, especially in urban areas with many tall buildings. Residents and workers in high-rise developments often look down on large expanses of ugly asphalt, tiles and slates and flat roofs.[140]

Plants can fulfill various social functions in an urban environment. Plants provide places for playing, sports, recreation, meeting, establishing social contacts, isolation and escape from urban life, aesthetic enjoyment, viewing buildings from a distance and so on.[141] There is no doubt that trees and parks help in creating a sense of

---

139. Dwyer, *The Deep Significance of Urban Trees and Forests*, 141-42.

140. J. Johnston and J. Newton, "Building Green: A Guide for Using Plants on Roofs, Walls and Pavements," *The London Ecology Unit* (1996).

141. B Givoni, "Impact of Planted Areas on Urban Environmental Quality: A Review," *Atmospheric Environment* 25B(3)(1991): 289-99.

community in the neighborhood, and the community can help growing plants. Community gardens can be visually entertaining and certainly add comfort and sense of relief to city living.

Figure 46 Carefully designed field (Photo by Gesner at Hokkaido, Japan)

4.2 Rooftop Farming

Situating environmentally low-impact hydroponic systems on existing flat roofs provides the urban farm with more space than it would have been available at ground level (Figure 47). Hydroponic agriculture is relatively light and thus installation on rooftops does not normally require significant structural reinforcement to the host building.[142] Hydroponic techniques are best suited economically and logistically to a range of vegetables that includes: leaf crops such as spinach, lettuce and other salad greens; vine crops such as tomato, cucumber, pepper, squash, beans, zucchini; and culinary herbs such as basil, parsley, chives and coriander.[143] These perishable crops travel a long way from farm to table and need to be kept cold and fresh for the entire route, increasing the energy burden.

142. Peter Droege, *100% Renewable : Energy Autonomy in Action* (London ; Sterling, VA: Earthscan, 2009), 234-38.

143. Ibid.

Figure 47 Hydroponic on roof top (Photo by Alex Wilson)

Green roofs present opportunities for residents to manage communal gardens above ground level. This promotes the feeling of ownership for their roof garden and fosters community interaction. Roof gardens on top of office buildings can provide an alternative place for employees to mingle in a more relaxed setting. Given the high premium areas at street level in the cities, roof gardens provide opportunities for more secluded, less polluted and less noisy space for informal recreation.[144]

Rooftop farms are becoming more popular, most notably at restaurants that focus on serving local foods, including The Bachelor Farmer in Minneapolis,[145] Uncommon Ground in Chicago,[146] and Bell Book & Candle in New York.[147] This form of urban agriculture can take advantage of unused existing spaces within the built environment, and create a sound and effective harmony of agriculture and architecture. However, rooftop farms are still in their infancy and have many hurdles to overcome,

144.Johnston and Newton, "Building Green: A Guide for Using Plants on Roofs, Walls and Pavements."

145."The Bachelor Farmer," The Bachelor Farmer, http://thebachelorfarmer.com/.

146."Uncommon Ground," http://www.uncommonground.com/.

147."Bell Book & Candle," Bell Book and Candle, http://bbandcnyc.com/.

such as building code restrictions and building-related structural deficiencies. For example, many existing structures do not have ADA accessible rooftops (they are inaccessible to those with physical disabilities) and were not built to carry the additional weight of plants and soil. Despite these difficulties, rooftop farms have begun to appear. They have the ability to aid many different applications – ranging from restaurants and grocery stores, to schools and hospitals. Each of these institutions already serves and/or sells food on - site and could benefit from growing their own produce instead of importing them from other sources.

A handful of architecture firms have begun designing concepts for new developments that integrate agriculture and architecture from the beginning of the design process. These concepts are not simply for new buildings with accessible reinforced roofs; they re-imagine the ways in which agriculture and architecture can exist cohesively within cities.

Figure 48 Rooftop farming (Photo by the Scientist Gardener)

4.3 Window Farming

Window farming has started to become popular among the people living in urban areas throughout the world. This movement, inspired by Britta Riley from Brooklyn, New York, is a simple but highly efficient DIY system for growing food in urban areas. Utilizing recycled plastic water bottles, plastic tubing, and simple aquarium air pumps, the window farmers are able to create indoor gardens that supply fresh vegetables and fruit year round for less than US$30.[148] Vertical hydroponic system is best suited for window farming which is optional to grow strawberries, bok choi, lettuce, cherry tomatoes and peppers in their city windows (Figure 49). It is very easy to build and matches nearly any kind of window types. It is not only visually appealing from inside or outside, but also blocks the direct sunlight to reduce the use of active solar systems.

Figure 49 Window Farming (Photo by Greenmuze staff)

148. Greenmuze Staff, "Urban Window Farming," Greenmuze, http://www.greenmuze.com/nurture/urban/2506-urban-window-farming-.html.

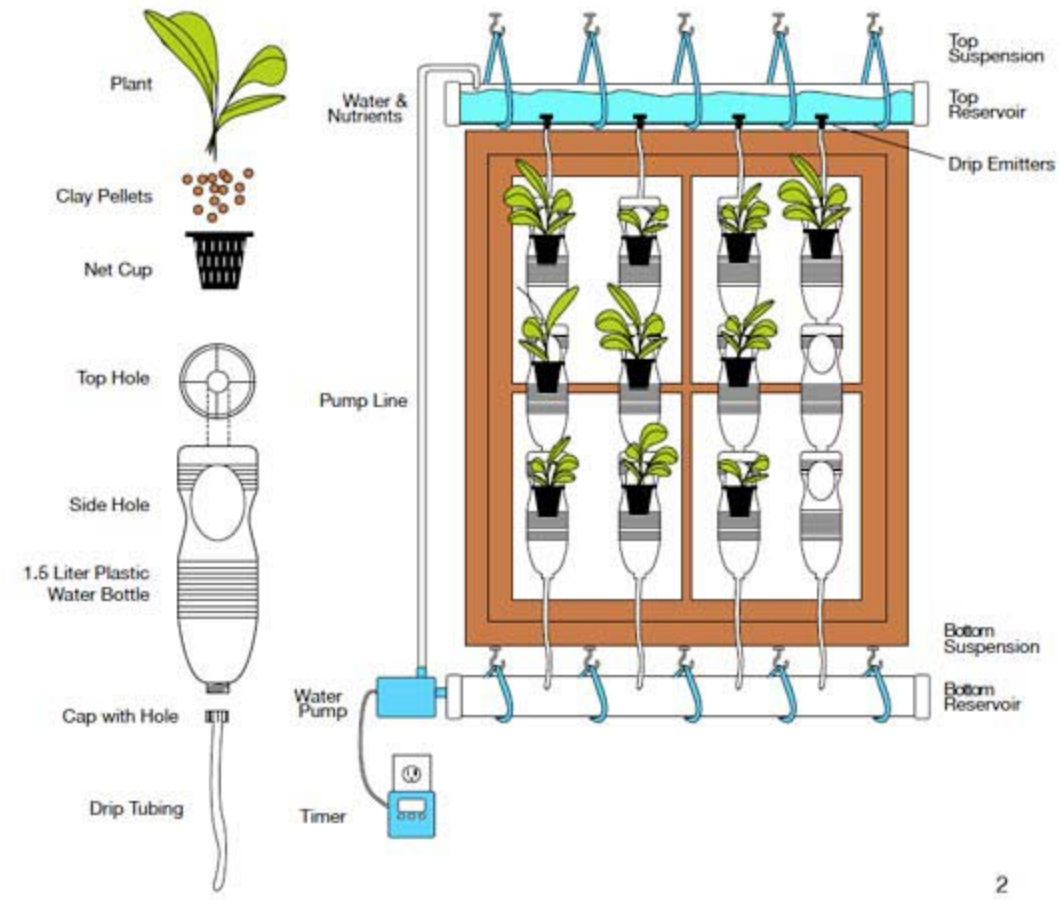


Figure 50 Diagram of window farming system (Diagram by Britta Riley and Rebecca Bray)

4.4 Balcony Farming

Typically, potted plants or hydroponic is employed for balcony farming, and the maintenance work is normally not very heavy (Figure 51). It is a well known methodology to initiate agriculture in private residences, and the balcony/terrace garden serves as a natural link between interior and exterior environments. Such a garden can be tended by the residents of the building, office workers or management agencies of any commercial buildings.

Figure 51 Balcony farming (Photo by flickr.com/boboroshi/)

4.5 Vertical Farming

Compared to a rooftop or flat ground garden, vertically placed greenery can cover more exposed hard surfaces in densely built-up environment, where high-rises are the predominant building style. Ken Yeang believes that:

> "This will significantly contribute towards the greening of the environment if a skyscraper has a plant ratio of one to seven, then the façade area is equivalent of almost three times the site area. So if you cover, let's say, even two-third of the façade, you have already contributed towards doubling the extent of vegetation on the site. So in fact a skyscraper can become green. And if you green it, you're actually increasing the organic mass on the site."[149]

Usage of vertical plants for various types of buildings is not a new concept; however, introducing plants to building façade is still a challenge strategically. According to the species of plants, types of growing media and construction methods, vertical landscaping can be divided into three fundamental types: wall-climbing, hanging-down and module (Table 6).[150] The wall-climbing type is a very common and traditional vertical landscaping method (Figure 52). Climbing plants can cover the walls most naturally, although it is a time-consuming process. Sometimes they are grown upwards with the help of a trellis or other supporting systems. The hanging-down type is also a popular vertical landscaping approach (Figure 53). Compared to the wall-climbing type, it can easily form a complete vertical green belt on a multi-storey building by planting at every floor. Lastly, the module type is a fairly new concept compared to the previous two. Initial construction is required to build up the supporting structure, but it has flexibility of growing media and plants (Figure 54).

149. Ken Yeang, *Dimensions of Sustainability : Architecture Form, Technology, Environment, Culture* ed. A. Scott (London: E & FN Spon, 1998), 109-16.

150. Nyuk Hien Wong, *Tropical Urban Heat Islands : Climate, Buildings and Greenery*, Spon Research (London ; New York: Taylor & Francis, 2009), 41.

Table 6 Comparison of three vertical landscaping methods

Type	Plants	Growing media	Construction type
Wall-climbing	Climbing plants	Soil on the ground or in planted box	Minimal supporting structure is needed
Hanging-down	Plants with long hanging-down stems	Soil in planted box on every storey	Planted boxes and supporting structure should be built at according storey
Module	Short plants	Lightweight panel of growing media (such as compressed peat moss)	Supporting structure for hanging or placing modules should be built on façades

Figure 52 Wall-climbing type of vertical farming (Photo by Interior Decoration and Design)

Figure 53 Hanging-down type of vertical farming (Photo by Naoki Koshiba)

Figure 54 Module type of vertical farming (Photo by Lloyd Alter)

4.6 Indoor Farming

Indoor farming has been practiced for some time mostly by using hydroponics and aeroponics. Strawberries, tomatoes, peppers, cucumbers, herbs, and spices grown in this fashion have made their way into the world's markets in quantity over the last 5-10 years. Most of these operations are small when compared to factory farms, but unlike their outdoor counterparts, they produce crops year-round. Also, it is almost entirely independent on what happens outside. Significant deviation (e.g., drought or flood) for more than several weeks away from conditions necessary for insuring a good yield has predictable, negative effects on the lives of millions of people dependent upon those items for their yearly food supply.[151] Japan, Scandinavia, New Zealand, the United States, and Canada have thriving greenhouse industries. Freshwater fishes, such as tilapia, trout, striped bass, carp, and a wide variety of crustaceans and mollusks, such as shrimp, crayfish, mussels, have also been commercialized in this way. Indoor hydroponic and aeroponic technologies has increased yield potential by more than 23 times while decreasing water usage by well over thirty times;[152] LED's (Light Emitting Diodes) and sulfer-mircrowave lamps are being employed as alternative light sources in agricultural environments which grow and harvest within 'biomass production systems' and 'plant research units' by the Bioregenerative Life Support Project at Dynamac, Inc., at the Kennedy Space Center. These are completely sustainable agricultural solutions which are constantly regulated, environmentally maintained, and hermetically controlled.

Indoor farming is also suitable for aquaponic technology (Figure 56). Aquaponic could be completely done indoors or combinations of roof top or balcony farming.

151. J. Cairns, "Sustainability and the Future of Humankind: Two Competing Theories of Infinite Substitutability," *Politics and the Life Sciences*, no. 1 (2000): 27-28.

152. Dickson D. Despommier, *The Vertical Farm : Feeding the World in the 21st Century*, 1st ed. (New York: Thomas Dunne Books/St. Martin's Press, 2010), 7.

Figure 55 Indoor farming (Photo by Arthur Max)

Figure 56 Indoor Aquaponic Farming (Photo by Bigelow Brook Farm)

5. Propositions and Comparative Study for Different Sites

In this chapter, various urban farming methodologies are studied in Shinjuku, Tokyo (see Appendix A: Greater Site Analysis for the further information.) 9 different sites were selected toward proposition and comparative studies; business, school, underground walkway, high and low-rise residence, hotel, government high-rise, park, and restaurant. There are numerous hidden agricultural potentials in the urban areas. Analyzing multiple possibilities and designing the agricultural field along with precedents, it will provide valid resource to realize the Cultivating Urbanism.

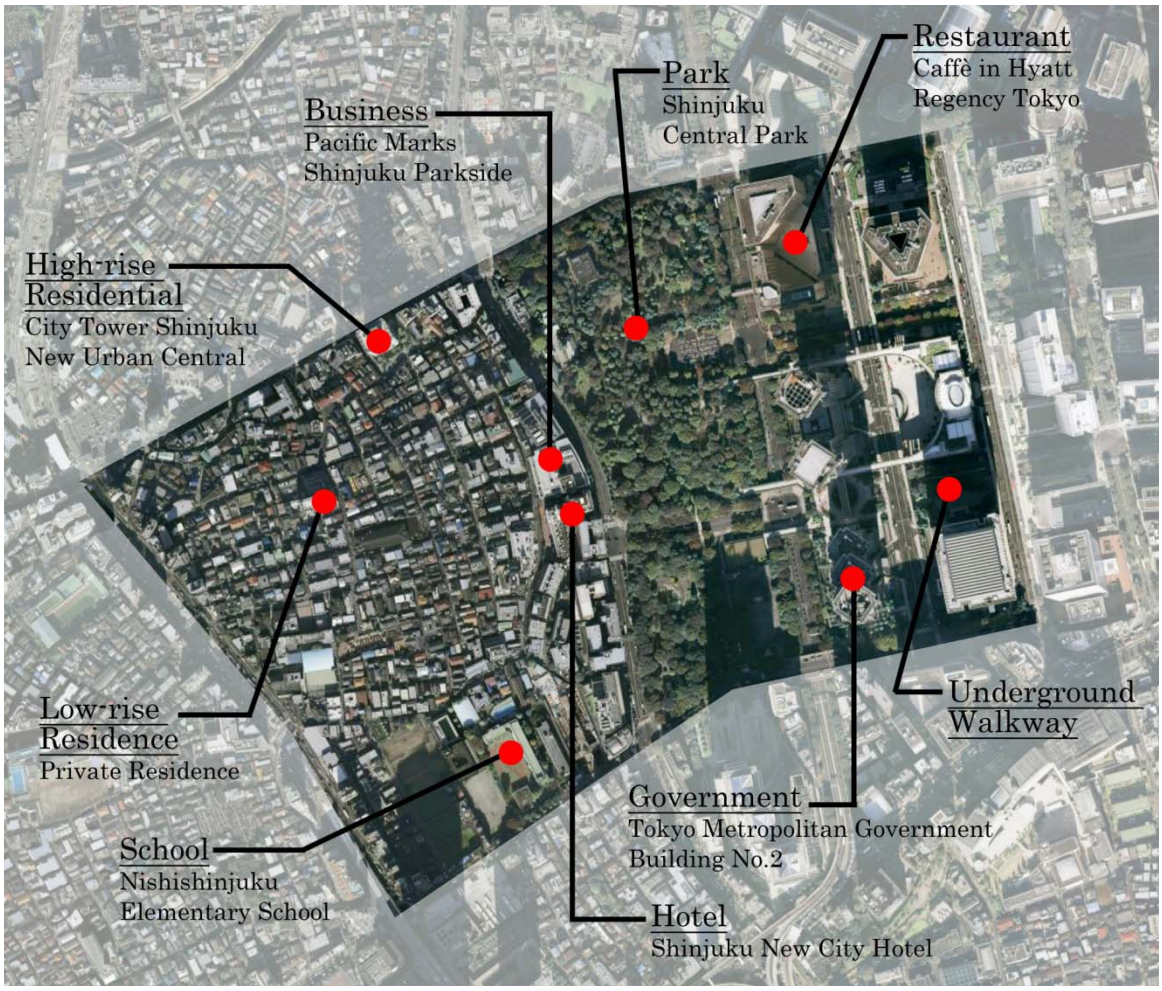


Figure 57 Site Map (Diagram prepared by Takao Ugai)

5.1 Business Farming

5.1.1 Precedent: Pasona Group Inc.

Figure 58 Pasona Group Inc. (top left: façade, bottom left: lobby, right: meeting room)
(Photo by Pasona Group Inc.)

The headquarters of Pasona Group Inc. is located in front of the Tokyo Station in the Marunouchi district of central Tokyo. Pasona is the largest temporary-employment agency in Japan. Numerous agriculture methodologies are employed inside their main building; such as window, rooftop, vertical, indoor and ceiling farming (Figure 58). They put importance in food security, food independence and psychological impacts that affect the office workers.

5.1.2 Site Description

Pacific Marks Shinjuku Parkside （パシフィックマークス新宿パークサイド）
(4-15-7 Nishishinjuku, Shinjuku Ward, Tokyo)

Figure 59 Pacific Marks Shinjuku Parkside (Photo by Google Map)

Pacific Marks Shinjuku Parkside is very typical 6 story business building in Tokyo. The lobby is located on the ground level, and all the other floors are leased by different private firms. There are almost no open spaces or recreational areas for employees mostly due to high land cost. Currently, most building rooftops do not allowpublic entry and reserved only for maintenance purposes. Establishing accessible flat rooftops seem to have the most potential for utilizing dead space and realizing meaningful value.

5.1.3 Opportunities and Constraints

Business farming could be managed in two ways; the community farming, where workload and responsibilities are shared among all building tenants, and individual farming owned and maintained separately by each tenant.

As shown on Figure 61, due to the orientation of the building, there is not much wall space with high solar radiations. However, most of the west side stepped walls will receive direct sunlight throughout the year, which enables vertical module farming from the roof top down. Also, the design of this particular business building is unique, and it could function as a terraced field with hydroponic system. Terraced fields decrease erosion and surface runoff, and they are effective for growing crops that require large amounts of water (Figure 60). Both of these vertical and roof top farms are administrated by the building manager, and all of the employees are encouraged to help out. They could go to the roof top during their breaks and relax, refresh, seed, water, harvest and even consume them. It will help reduce office workers' stress, stimulate interaction, broaden their community, and enhance their food habitats. All of these positive effects will lead to an improvement of working productivity and quality of office life (see Chapter 3.1.2 Psychological Impacts).

Figure 60 Terraced field in Sapa (Photo by Asia Charm Tours)

Indoor farming can also create similar effects to the employees, and it can be managed in two styles; community farming and business farming. There are two major differences between them. One is the administrative system, which requires each individual office to maintain the farms. They could utilize automated watering system or assign building managers to look after the plants during the weekends and holiday seasons as necessary. The second difference is that indoor plants can become a part of the office workers' lifestyle because they are present in the same space at all times. Indoor plants can not only add beauty and warmth to the space, but the extensive direct exposure to such plants can also bring about positive psychological impacts much more than rooftop farming which is remote.

Table 7 Pacific Marks Shinjuku Parkside

Roof Top	Administrator	building manager, outsourcing
	Participants	office employee
	Methodology	hydroponic
	Plants	cabbage, carrots, cucumber, lettuce, onions, wheat
	Storage	storage
	Consumption	office employee
Indoor (office)	Administrator	administrative assistant
	Participants	office employee
	Methodology	aeroponic
	Plants	asparagus, cucumber, tomato
	Storage	storage
	Consumption	office employee
Vertical	Administrator	building manager, outsourcing
	Participants	office employee
	Methodology	module
	Plants	cucumber, potatoes, tomatoes
	Storage	storage
	Consumption	office employee

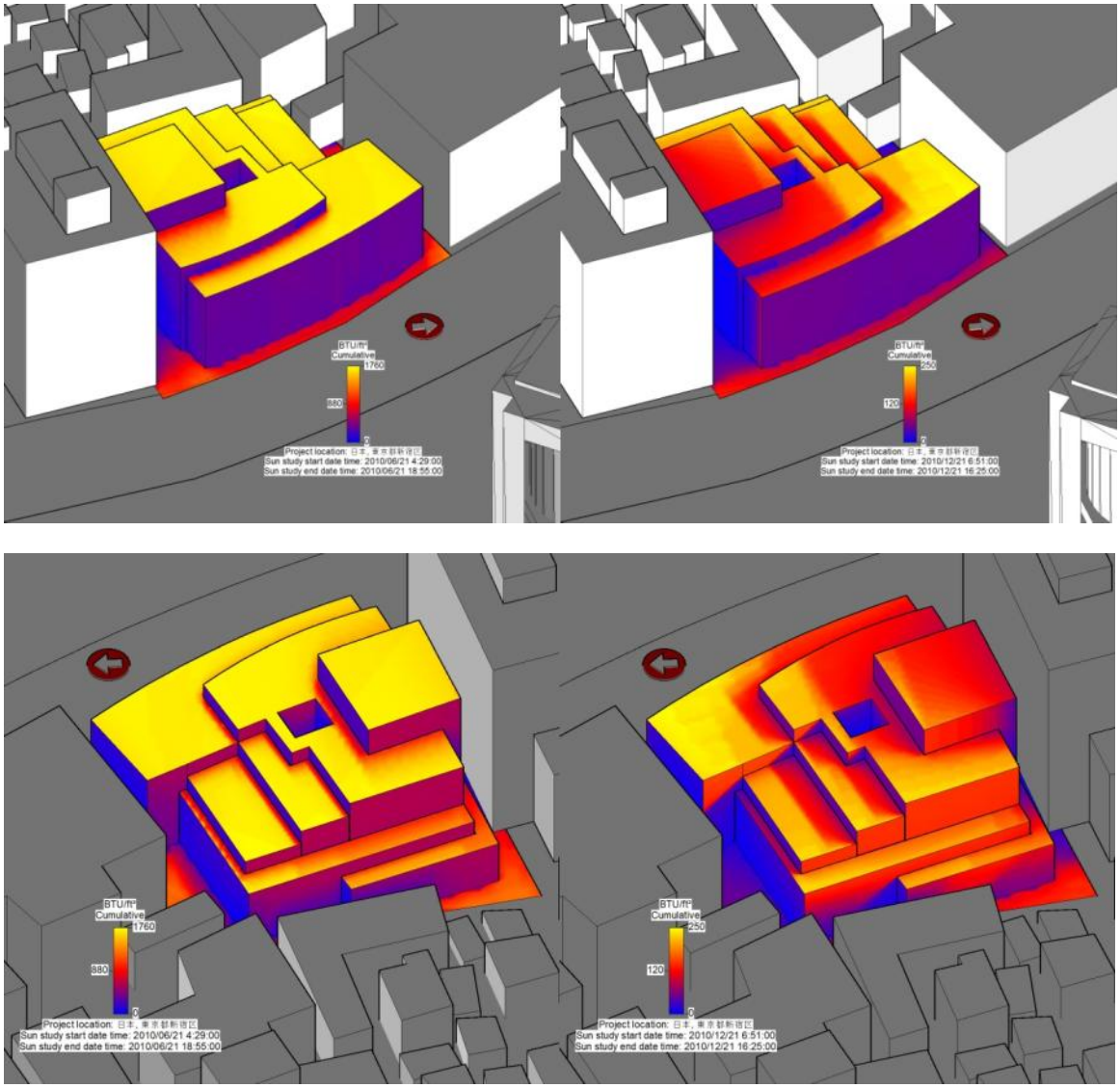


Figure 61 Solar radiation analysis of business farming (left: summer solstice; right: winter solstice) (Image analyzed and rendered by Takao Ugai)

The interior space that has chosen to investigate is the second and third floors of this tower. These spaces are leased by a private firm. Since the firm deals with many papers and computers, they must avoid any water damage and excessive moisture, and the interior farming areas must be carefully designed. It is not reasonable to take the risk of ruining valuable resources and equipments, so that the planters will be located in the common areas. These areas are accessed by all employees and exposed to the visitors; therefore visual impacts will be maximized. Maintenance will be easier in an open area without having to interrupt the employees.

The designated areas are color coordinated for potential interior farming (Figure 62 and Figure 63). They are separated into two different categories; circulations and meeting areas (Figure 64). It should not only for cultivate crops but also visually appealing to the employees and the visitors. The second floor is mainly for reception and meeting rooms with supplemental offices on the side. The area should concentrate on enhancing the visual presentation of the plants and communicating the "green and sustainable image" and emphasize the firm's awareness and enthusiasm for involving in the environmental issues.

The third floor is where all of the main internal offices are placed with no outside visitors or guests accessing the area. This is the most active and heavily used floor and includes casual meeting spaces and a kitchen. The agricultural design on this floor should focus on promoting productivity and comfort. Also, many office workers will enjoy having lunch in these offices, so the selection of vegetables and perhaps some fruits should be based upon what is most desired for consumptions.

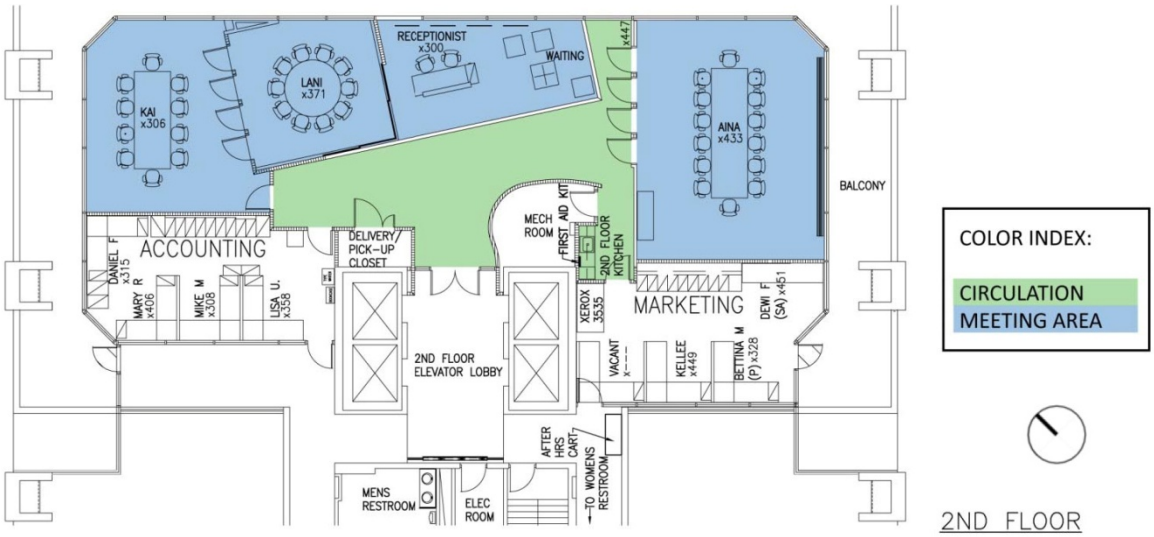


Figure 62 Second Floor Opportunity Areas for Indoor Farming (Image prepared by Takao Ugai)

Figure 63 Third Floor Opportunity Areas for Indoor Farming (Image prepared by Takao Ugai)

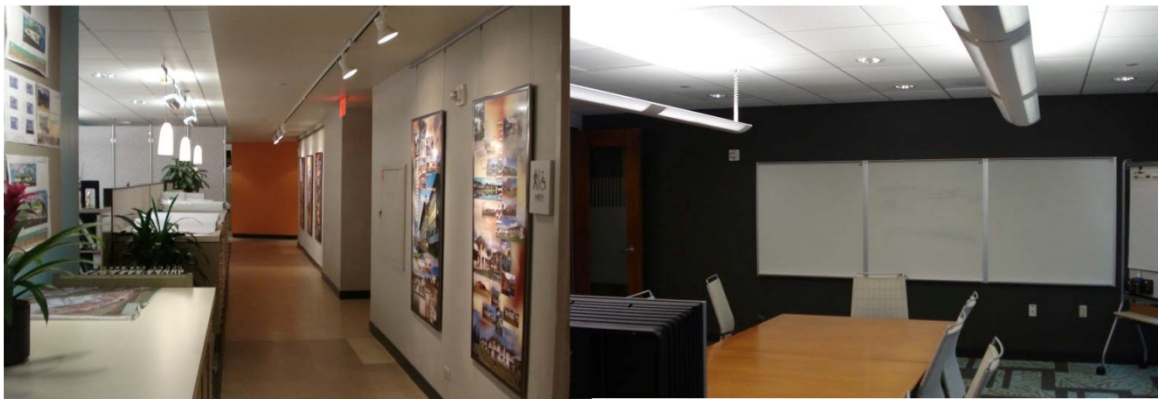


Figure 64 Picture of Corridor (left) and Conference Room (right) (Photo by Takao Ugai)

5.1.4 Adaptation Proposals

Three agricultural fields are studied in the private office that are Hallway, two Elevator Lobbies, and Reception Desk/Conference Room (Figure 65). From the previous section, Opportunities and Constraints, all of these areas have high workability, accessibility, irrigation, and moreover, maximum visual exposure. I also studied two community farmings on the rooftop and ground level lobby area.

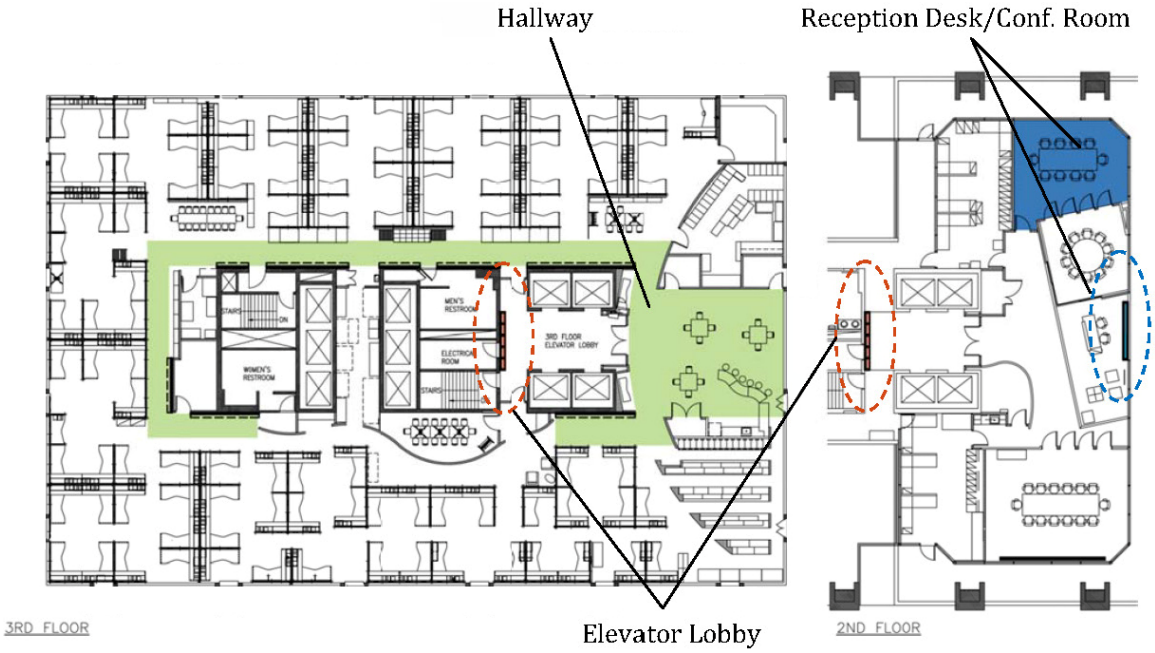


Figure 65 Proposed Floor Plans (Image prepared by Takao Ugai)

5.1.4.1 Hallway

A hallway is typically the main place for circulation and relaxation. In this building, the hallway is located on the 3rd floor, where there is most foot traffic. Weekly coffee break meetings and lunch time presentations are held in the relaxation areas. Since these areas are heavily utilized by the employees on a regular basis, the main focus of the design should be on catering to employee needs and how to provide relaxation and comfort to the space.

When I thought about relaxation, the aquaculture came to my mind. 70% of aquarium owners said that their fish calmed them, helped them to relax, and reduced their stress.[153] Unfortunately, aquaponics are a relatively new technology, and there are no academic reports regarding its effect on reducing stress; however, aquaponics might even more beneficial then aquaculture and have the same positive effects by adding the hydroponic farm on the ceiling.

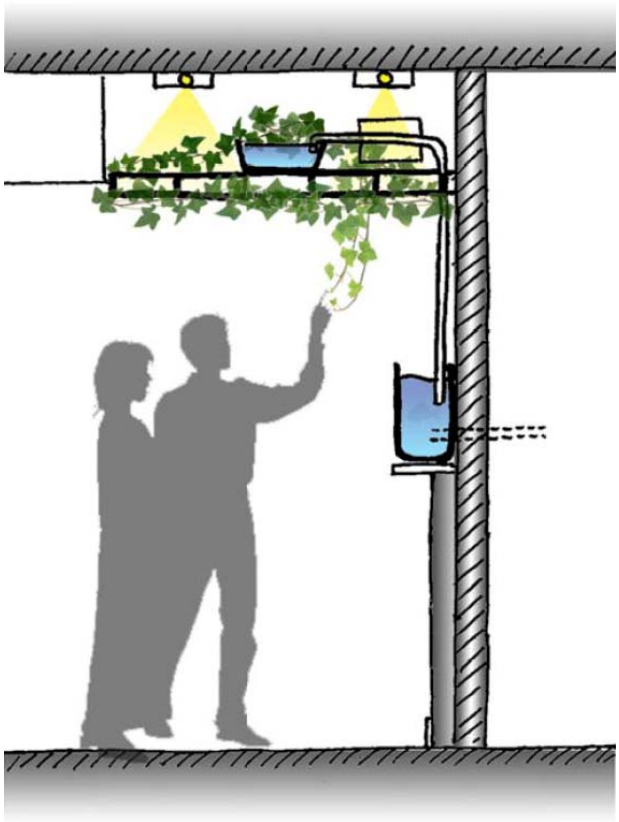


Figure 66 Section Diagram of Aquaponics at Hallway
(Diagram prepared by Takao Ugai)

The section diagram of aquaponics in the hallway has been carefully designed as shown (Figure 66). Both aquaculture and hydroponics must not obstruct any

153. Aline H. Kidd and Robert M. Kidd, "Benefits, Problems, and Characteristics of Home Aquarium Owners," *Psychological Reports* Volume 84, no. Center for Animals in Society, School of Veterinary Medicine, University of California-Davis: 998-1004.

traffic, but at the same time, they must be physically accessible and well visible.

The aquaculture is placed along the existing walls supported by new half-height light gauge steel studs wall. The water circulates to the hydroponics up on the ceiling via a 1" diameter polyvinyle chloride piping. The hydroponics are supported by 5'x5' suspended metal frame and illuminated by two-fluorescent lights (Figure 67). Any water loss thru evaporation will be compensated by using the restroom water line.

This is a very standard aquaponic system which requires very limited maintenance as long as the ratio of fish and plants are correct. The only task that employees are required to do is to feed the fish everyday, which can be very enjoyable for many people and the tanks and filters need to be cleaned once a month by an outside vendor.

Figure 68 is the rendering image of the hallway. You can see the plants hanging down from the ceiling and aquaculture (aquarium) along the wall. It makes the space very pleasant and elegant.

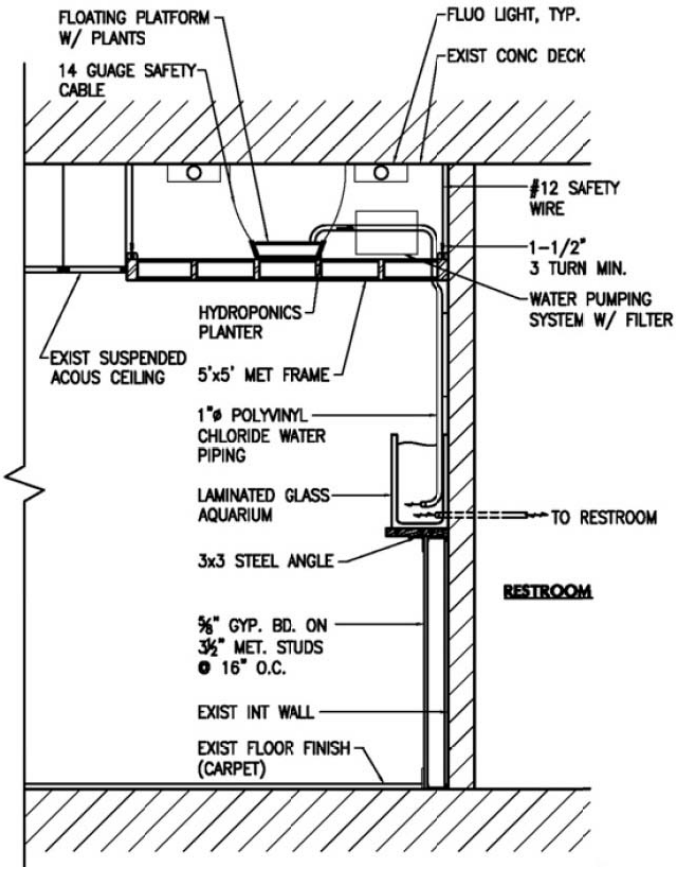


Figure 67 Wall Section Detail at Hallway
(Drawing prepared by Takao Ugai)

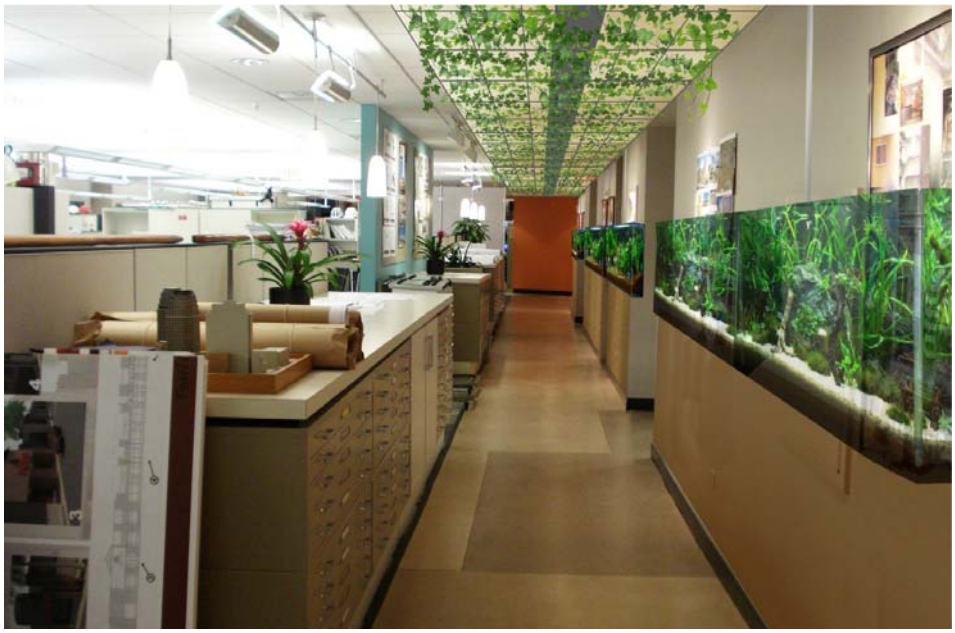


Figure 68 Rendering of Hallway (Rendering prepared by Takao Ugai)

5.1.4.2 Elevator Lobby

The firm would have two elevator halls on the second and third floors. These elevator halls are used by all of the employees, consultants, clients and any guests. These areas should concentrate on visual appearance that conveys the company's "green" image.

In order to demonstrate the different types of agricultural methodologies, a vertical garden was designed with conventional farming by utilizing the existing lighting fixtures (Figure 70). The Gro-Wall unit product was specified which makes the construction of the vertical garden fairly easy. Those units are supported by aluminum angles attached to the existing walls. The existing walls will be finished with 1/2" thick cement board for water resistance purposes. At the bottom of the vertical garden, copper flashing and drip tray will be laid. As for the irrigation system, the dripping system was selected to enhance the water efficiency (Figure 70).

This gardening will be very visually appealing with very low initial costs (Figure 71), and only requires moderate maintenance requirements. The company logo or a special embellishment can be placed inside the vertical garden to emphasize that the film is environmentally conscious and active.

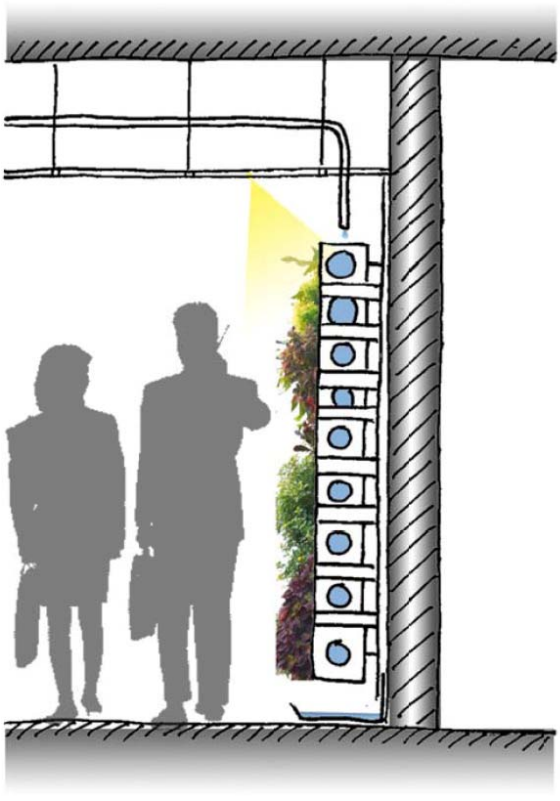


Figure 69 Section Diagram of Vertical Garden at Elevator Hall (Diagram prepared by Takao Ugai)

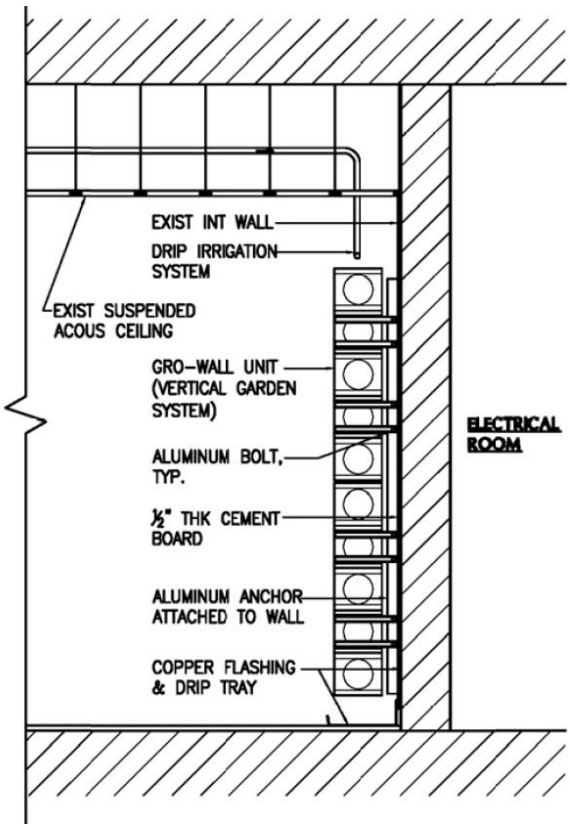


Figure 70 Wall Section Detail at Elevator Hall (Drawing prepared by Takao Ugai)

Figure 71 Rendering of Elevator Hall (Rendering prepared by Takao Ugai)

5.1.4.3 Reception Desk/Conference Room

Third location is the reception desk and conference room. These areas are mainly for the clients and guests and it should demonstrate the "green" image of the company. The aquaculture was designed to be placed behind the reception desk. The water circulates through the ceiling and to the hydroponics in the meeting rooms.

It will not only enhance the company image but also relieve peoples' stress, and promote mental and emotional health. There is a great possibility that more "green" environment can reduce frivolous arguments and unnecessary disputes. As shown on Figure 72 and Figure 73, the basic agricultural system is similar to Chapter 5.1.4.1 Hallway.

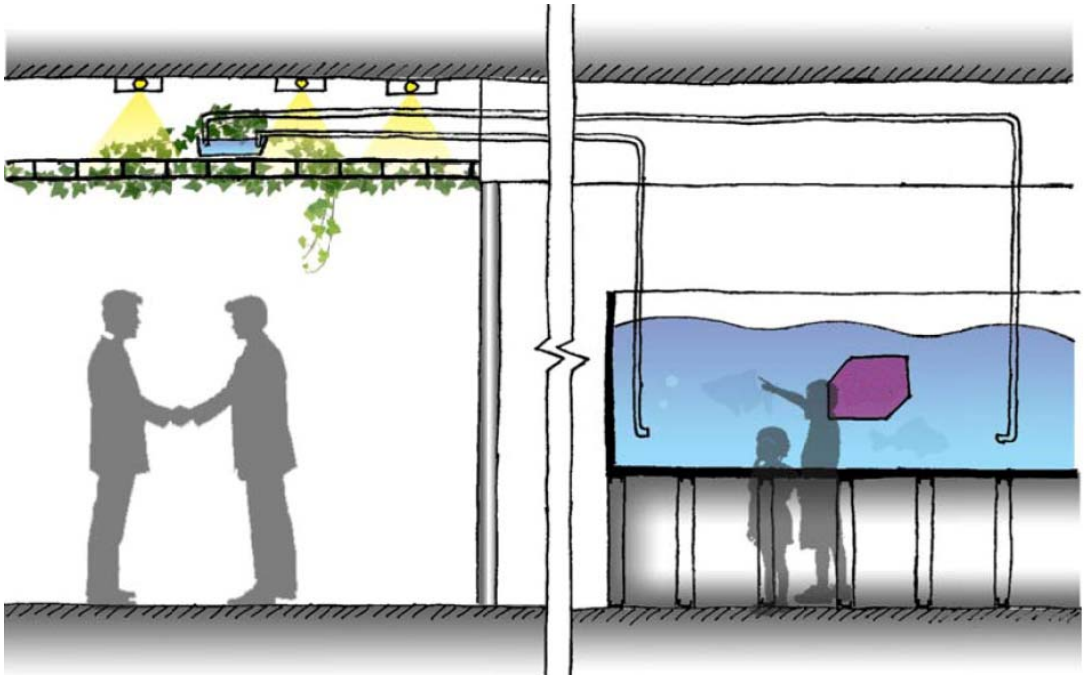


Figure 72 Section Diagram of Aquaponic (Diagram prepared by Takao Ugai)

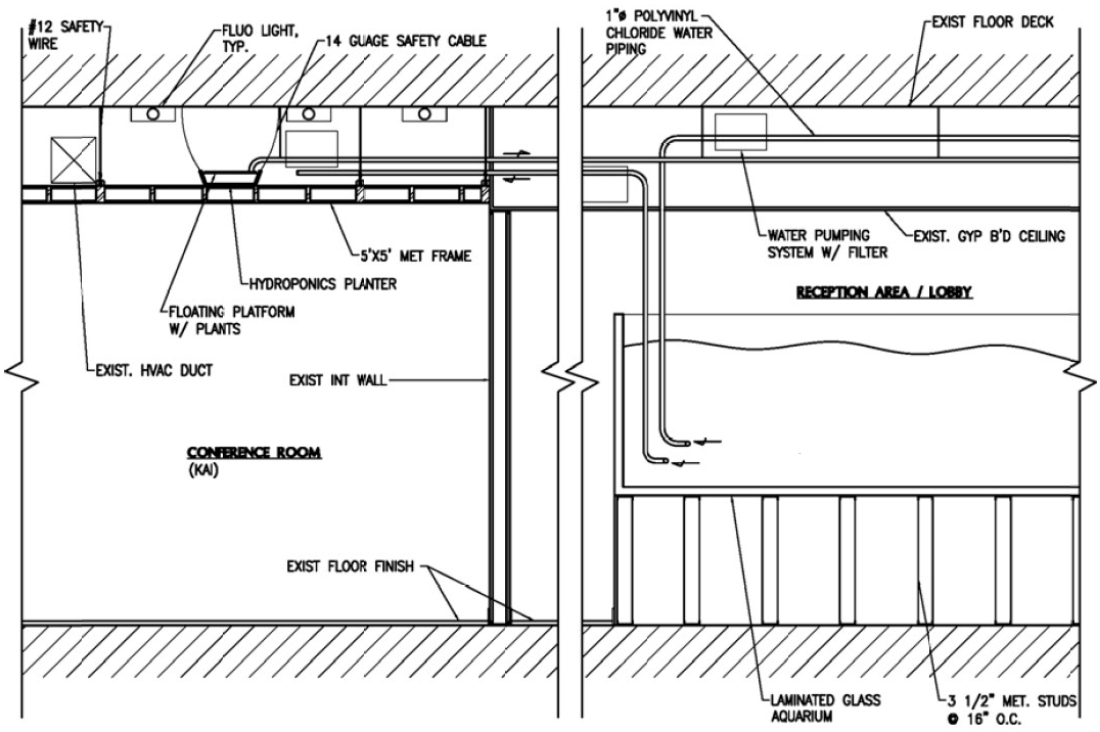


Figure 73 Wall Section Detail (Drawing prepared by Takao Ugai)

Figure 74 Rendering at Reception Desk (Rendering prepared by Takao Ugai)

Figure 75 Rendering at Conference Room (Rendering prepared by Takao Ugai)

5.1.4.4 Rooftop

As mentioned in Opportunities and Constraints, this particular business building is suited for applying terraced field with hydroponic system. The water is connected throughout the system and flow from the highest area of the roof to the lowest areas (Figure 76). It uses gravity to circulate the water, so that no mechanical system is required. Recreational areas are located for the employees to refresh, socialize, and eat lunch.

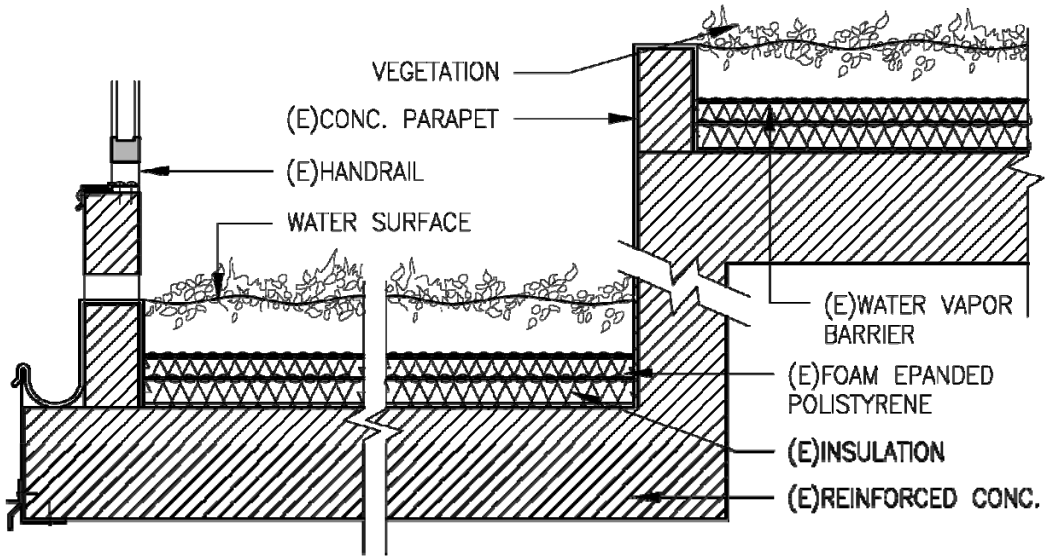


Figure 76 Detailed Section Drawing of Terraced Hydroponics at Rooftop
(Drawing prepared by Takao Ugai)

Figure 77 Rendering of Rooftop Terraced Farming (Rendering prepared by Takao Ugai)

5.1.4.5 Entrance Lobby

This lobby farming will give great impact to the employees and guests. The lobby is the face of a building and people pass through the area at least twice a day. Since these people come from different cities, prefectures or even countries, I believe the lobby area has great potential to raise awareness and spread the idea of urban agriculture. Events and activities like farmers market can also be hosted to provide fresh and nutritious seasonal vegetables and fruits.

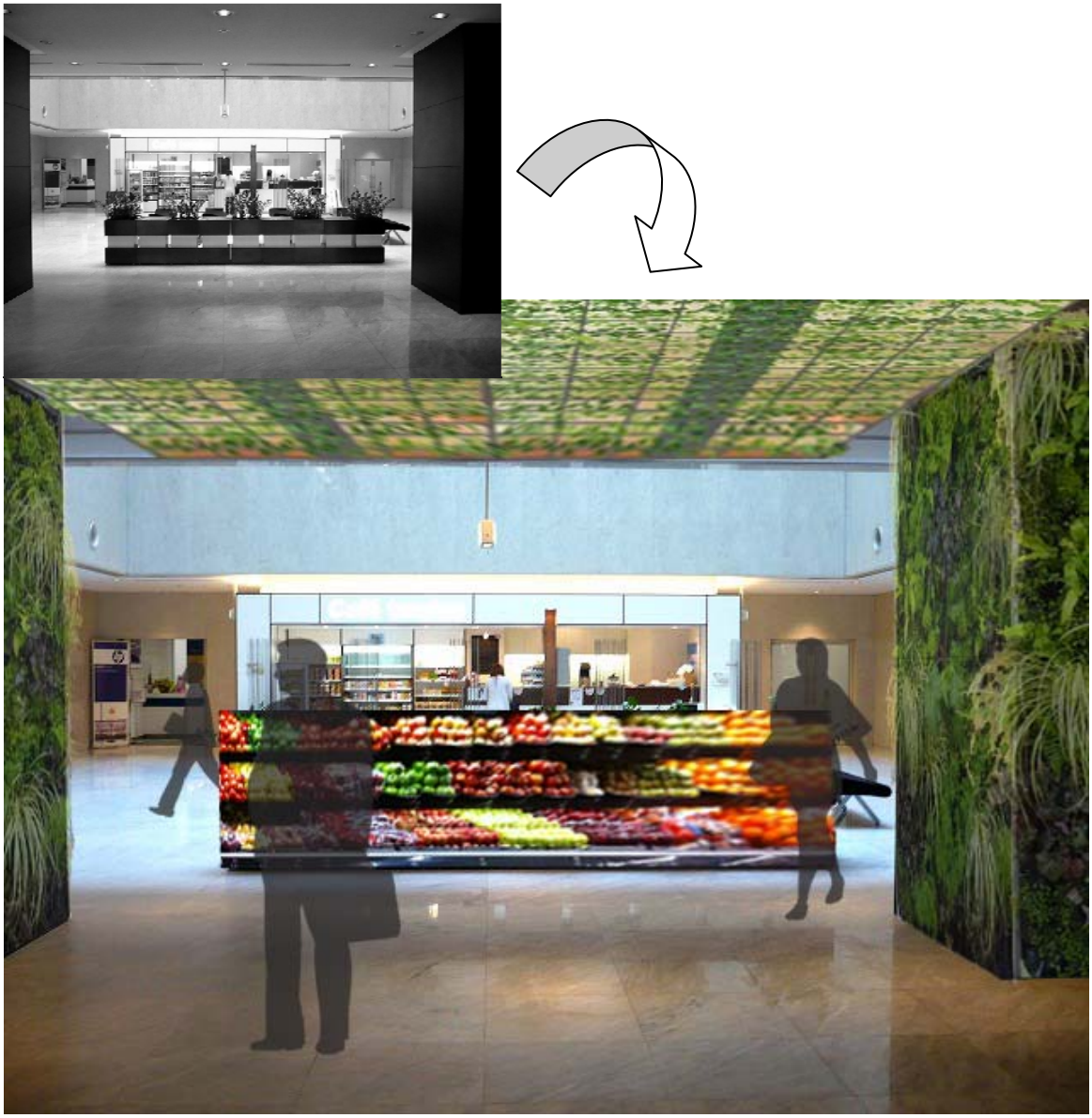


Figure 78 Before and After Rendering of Lobby Farming and Farmers Market
(Rendering prepared by Takao Ugai)

5.2 School Farming

5.2.1 Precedent: Ballymaloe Cookery School

Figure 79 Ballymaloe Cookery School (Photo by mnn.com)

This cookery school in County Cork, Ireland is not in an urban area, but their serious consideration for the importance of farming and food safety qualifies them as a valid precedent of school farming for this dissertation.

The president, Darina Allen started the school in 1983, because she was an Ireland's best-known chef and her husband, Tim, was a farmer, and they wanted to create something that was based at their home. They believe that "This connection between farming and cooking is vital."[154]

Unlike any other cookery school in the world it is located in the middle of a 100-acre, organic farm, of which ten acres is devoted to organic market gardens, orchards and greenhouses. This means that the students can learn to cook using the finest and freshest of ingredients. It also means guaranteed quality and variety. For instance, they grow over 40 different types of tomatoes alone.[155]

---

154. Ballymaloe Cookery School, "About the Ballymaloe Cookery School," Ballymaloe Cookery School, http://www.cookingisfun.ie/pages/about_us/.

155. Ibid.

5.2.2 Site Description

Nishishinjuku Elementary School （西新宿小学校）
(4-35-5 Nishishinjuku, Shinjuku Ward, Tokyo)

Figure 80 Nishishinjuku Elementary School (Photo by Kirijinri)

Nishishinjuku Elementary School is a public school built in 1997. It is a medium size school with a decent gymnasium, swimming pool and some open field. There is also a public kindergarten within the property which shares common areas with the elementary school. All things considered, this school is an average normal public school in any urban areas; however, as you can see in the picture above, it is void of greenery and significantly lacks plants or flowers.

5.2.3 Opportunities and Constraints

School farming is the most beneficial way to pursue “shokuiku” (see Chapter 2.2.2 for description). Recently, the number of children suffering from nature deficit disorder is increasing, especially in urban areas.[156] Through actively participating in farming and experiencing growing, harvesting and cooking such plants vegetables, our children can not only enjoy eating them, they can also learn and appreciate varieties of

156.Louv, *Last Child in the Woods : Saving Our Children from Nature-Deficit Disorder*, 34.

vital things such as ecosystems, farming methodologies, importance of living nature, cooking skills, eating manners, and how to work and help each other. Farming would be mainly instructed by the school teachers, but local professionals, dieticians, nutritionists, farmers, scientists, researchers, etiquette experts and chefs for instance, should be invited to educate and share their advanced knowledge and skills.

In order to maximize the benefit of "shokuiku," the aquaponics system can be implemented to school farming, because it is very similar to how the natural ecosystem works and the best way for students to learn. The roof of the school is flat and there are vast spaces with high sunlight radiation (Figure 81). These roof tops could be utilized to build an aquaponics system by integrating main building for hydroponics and secondary building for aquaculture. It shall cultivate nutrient-dense and colorful vegetables such as broccoli, cabbage, carrots, lettuce, onions and tomatoes. The harvested crops will be stored and cooked in the school kitchen. The structure systems of school buildings are extremely sturdy, so that these conversions will not compromise the structure or disturb the occupants. Schools are designed to sustain severe situations not only for the children's safety but for sheltering local people during disasters.

The ground area should be open for children to play outdoor sports. Also, all of the walls should not be completely covered with plants, considering the benefits of natural sun lights reaching into classrooms, as opposed to rooftops and walls of gymnastic stadium could be covered by extensive green. Extensive green roofs, on which only low maintenance and self-generative plants (turfing/grass is common) can be planted, feature lightweight and low maintenance growing media.[157] It could be integrated on pitched or curved roofs in order to reduce the unnecessary solar radiations and stormwater.

157.Wong, *Tropical Urban Heat Islands : Climate, Buildings and Greenery*, 39.

Table 8 School farming

Roof Top (school)	Administrator	teachers, researchers
	Participants	students
	Methodology	aquaponics
	Plants	broccoli, cabbage, carrots, lettuce, onions, tomatoes
	Fish	tilapia, trout, shrimp, crayfish, mussels
	Storage	school kitchen
	Consumption	school lunch/farmers market
Roof Top & Walls (gymnastic)	Administrator	teachers
	Participants	students
	Methodology	extensive green
	Plants	turf, grass
	Storage	N/A
	Consumption	N/A

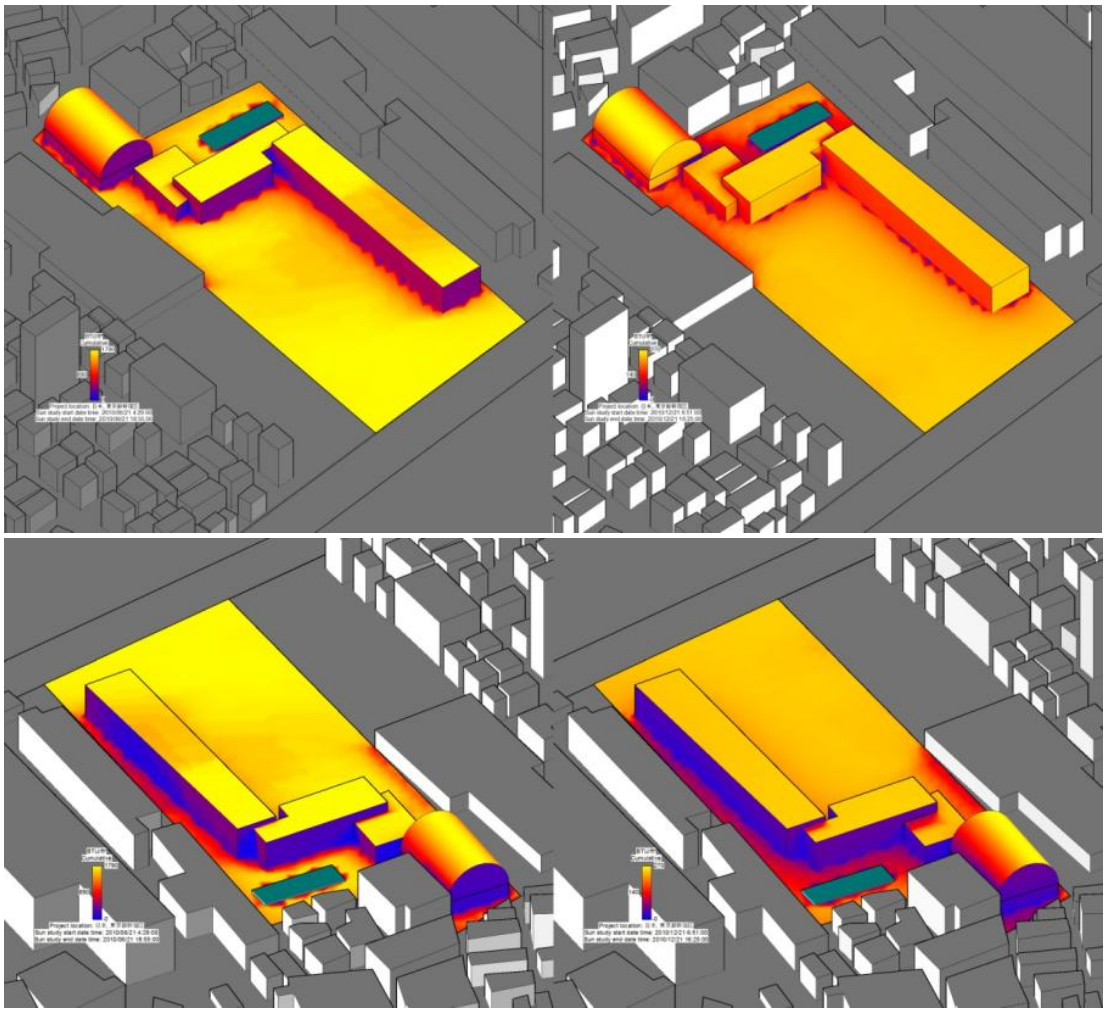


Figure 81 Solar radiation analysis of school farming (left: summer solstice, right: winter solstice)

(Image analyzed and rendered by Takao Ugai)

5.2.4 Adaptation Proposals

Agricultural fields are adapted on the rooftop of school facilities and vertical walls/arched roof of gymnasium (Figure 82). The main concentration of this design is on educational purposes. The agricultural fields must not only be safe with high workability but also useful as an educational tool that showcases the natural ecosystems.

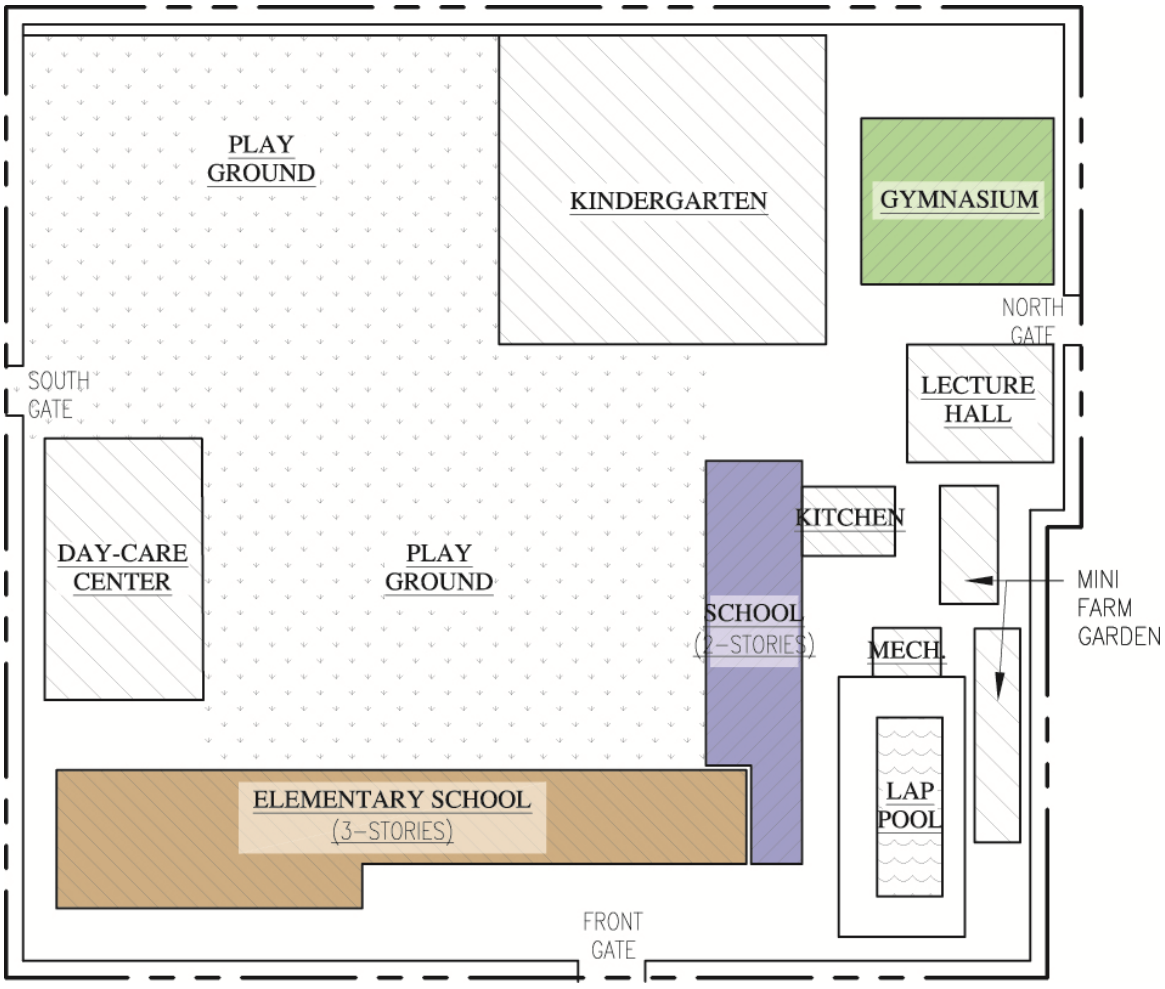


Figure 82 Site Plan of Nishishinjuku Elementary School (Image prepared by Takao Ugai)

5.2.4.1 School

As mentioned in Opportunities and Constraints, the aquaponics system best suit the school farming. In order to keep the mechanism clear and simple, the hydroponic and aquaculture tanks are distinguished and placed on two different roof structures, while clearly showing the visible connection between the two tanks, which makes it easy for the teachers to explain the system. Additionally, students can work in teams and learn how to collaborate with each other in achieving common goals

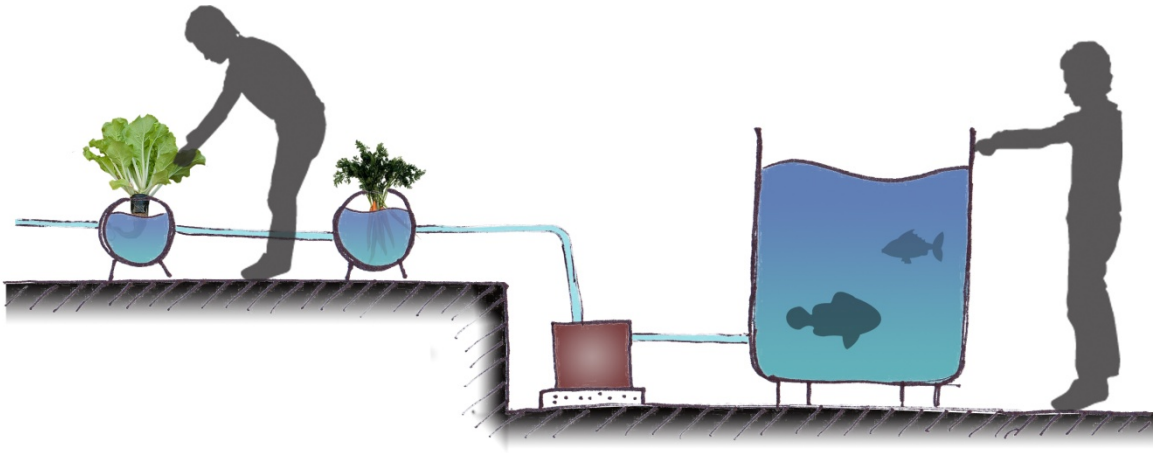


Figure 83 Section Diagram of Aquaponic School Farming (Diagram prepared by Takao Ugai)

Figure 84 Before and After Renderings of Hydroponic Rooftop (Rendering prepared by Takao Ugai)

Figure 85 Before and After Renderings of Aquaponic Rooftop (Rendering prepared by Takao Ugai)

5.2.4.2 Gymnasium

As mentioned in Opportunities and Constraints, gymnasium is exposed to vast amount of direct sunlight with very low workability. However, the gymnasium only has small windows with no mechanical ventilation, and so it is extremely hot during summer. To remedy the problem, uncultivable green roof (extensive green roof) and vertical garden should be adapted to enhance the insulation. The enhancement will improve the industrial appearance of the structure to more warm and natural one, which also helps to better the school image (Figure 86).

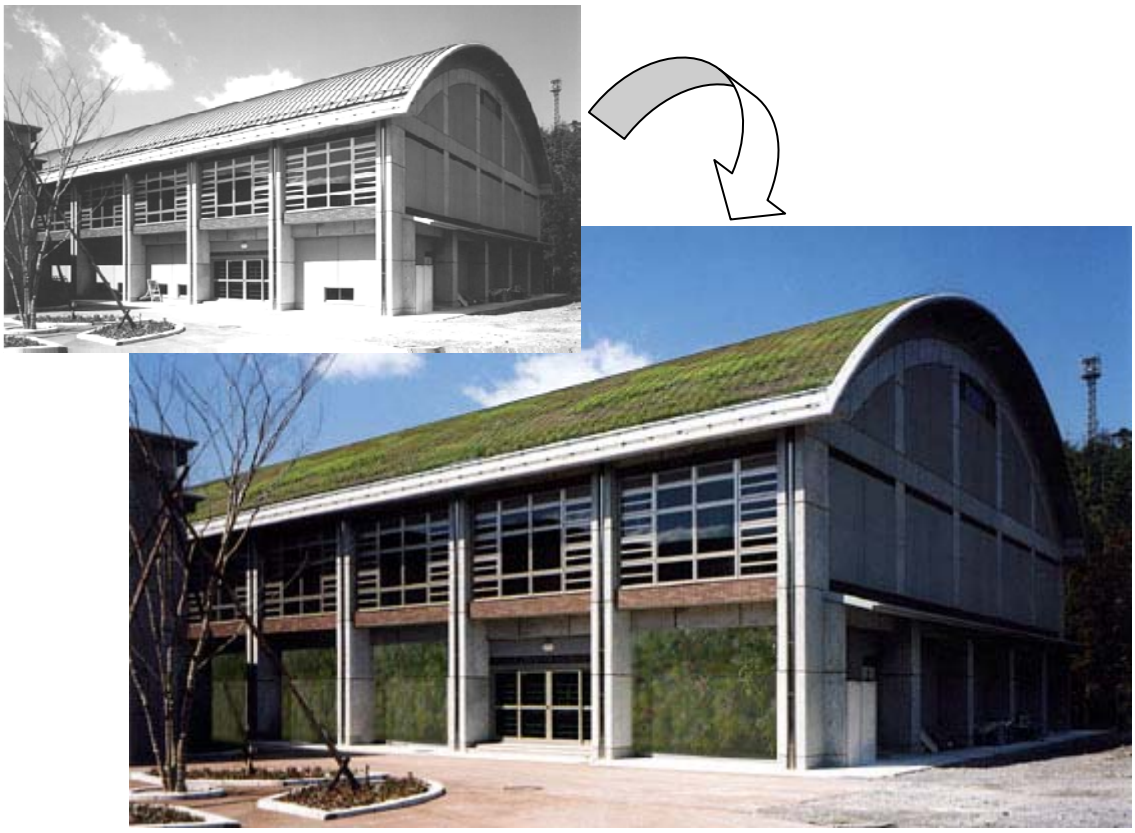


Figure 86 Before and After Renderings of Gymnasium (Rendering prepared by Takao Ugai)

5.3 Underground Walkway Farming

5.3.1 Site Description

In Shinjuku, there is a very long underground walkway that directly connects the Shinjuku Station and the Tokyo Metropolitan Government Building. It has exits to the major business buildings in West Shinjuku, and the majority of commuters and visitors heavily use this pathway. It takes about 20 minutes on the horizontal escalator from one end to the other.

Figure 87 Underground Site Map, walkway is indicated in blue color
(Image prepared by Takao Ugai; base map by Yahoo! Japan Local)

5.3.2 Opportunities and Constraints

The current walkway is empty and void of greenly, but by filling the walls with plants, it will enhance the quality of space and reduce the office workers' commuting stress every morning and evening.

No major construction would be required, but rather, prefabricated aeroponic module can be installed on the existing walls, and existing lightings should be replaced with LEDs that promote the plants' growth. The maintenance will be administrated by civil servants and private researchers, and local volunteers will help maintain the farm. There will be miscellaneous people using the walkway, but there are existing security cameras installed on the ceilings to prevent vandalism (Figure 88).

The Urban Agricultural Department in Kogauin University will grant the open space inside the underground walkway for the education and research purposes, and in return, they will be responsible for maintaining the healthy communities and farmlands.

Table 9 Underground Walkway Farming

Vertical (indoor)	Administrator	Kogakuin University
	Participants	students from Kogakuin University, civil servants and volunteers
	Methodology	module aeroponic
	Plants	cucumber, potatoes, tomatoes
	Storage	Tokyo Metropolitan Government Building
	Consumption	civil servants, visitors and school lunch

Figure 88 Underground Walkway (Photo by Shu Architects Inc.)

5.3.3 Adaptation Proposal

The methodologies of Underground Walkway Farming are fairly simple. Aeroponic systems are attached on the existing walls and columns (see Chapter 3.3.3 Aeroponic Farming for system details). It does not require any structure system, but new plumbing system must be constructed. The key to this design is to seal the gridded module as much as possible. If there is an opening to the grid system (which is holding the plants), there are risks of major evaporation, contamination and condensation. The aeroponic system has multiple benefits; requires least amounts of water compared to all of the other farming methodologies, minimum labors, and visually appealing design. For these reasons, the construction must be done very carefully with pre-engineered materials.

The farms will be maintained by community which is administrated by Urban Agriculture Department in Kogakuin University (see Chapter 1.2 New Prospects for a Synthesis of the City and Agriculture for issues and proposals of community farm.)

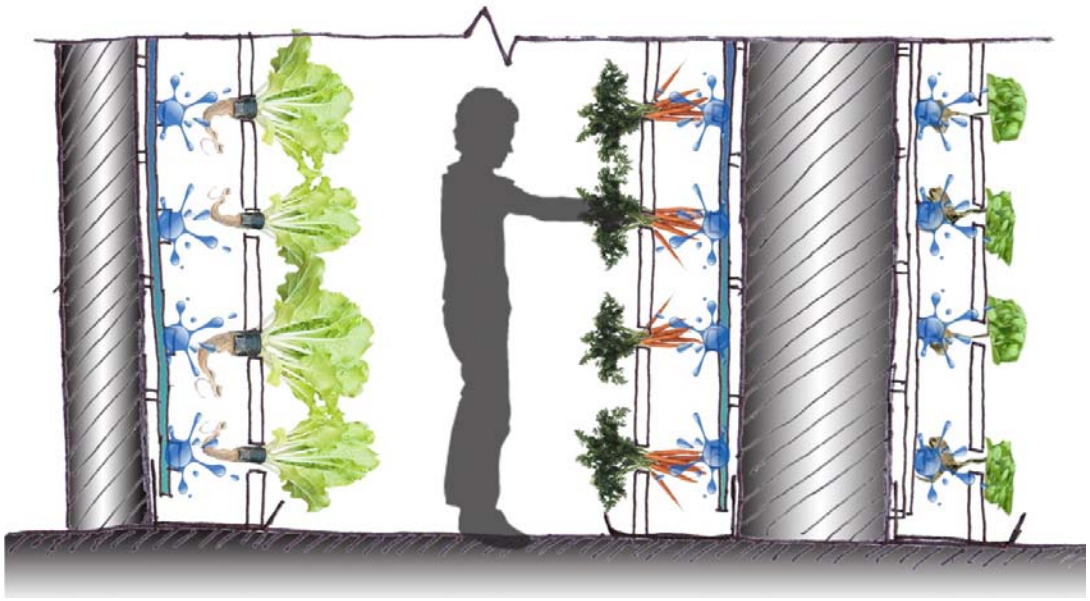


Figure 89 Section Diagram of Aeroponic Underground Walkway (Diagram prepared by Takao Ugai)

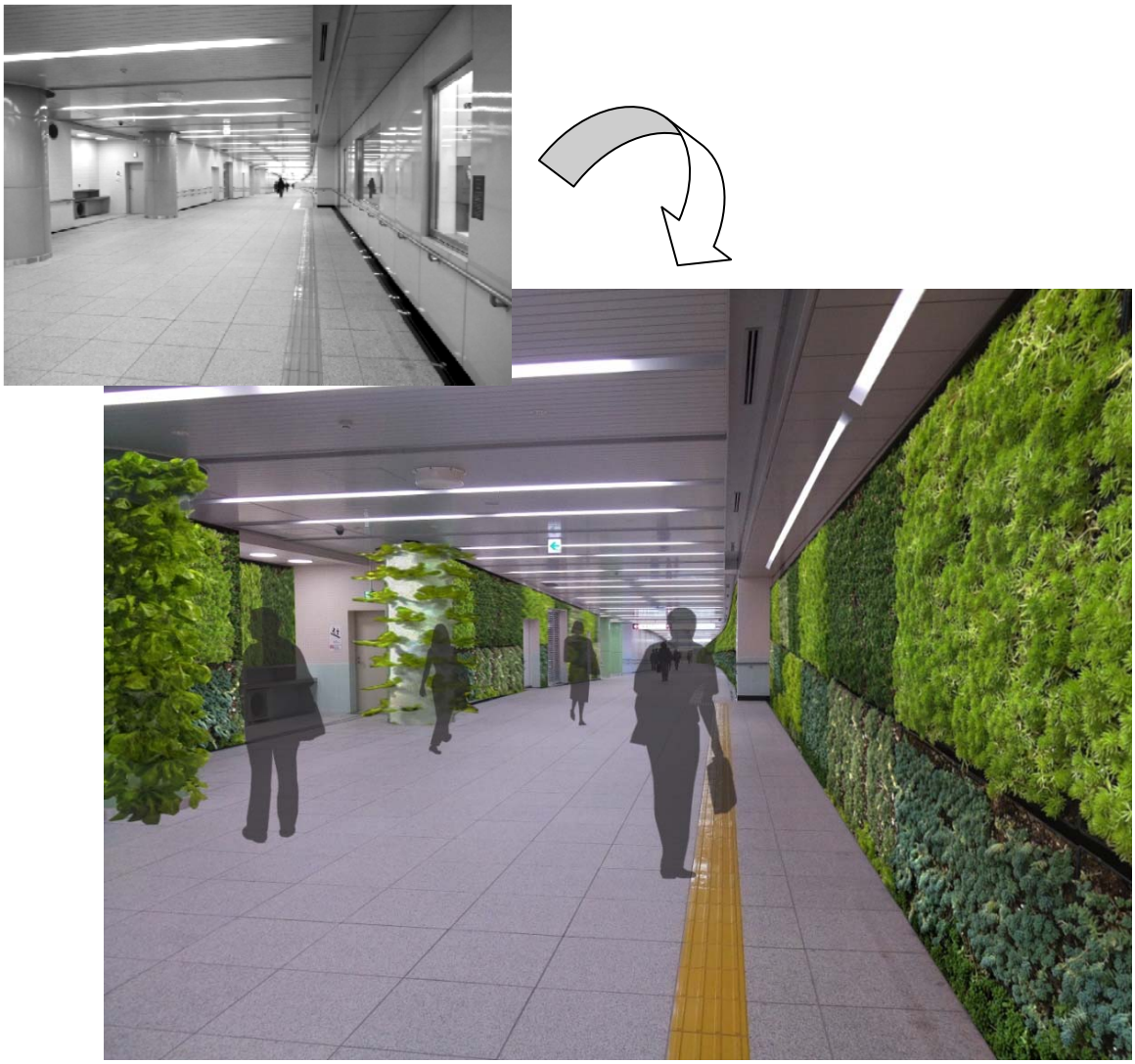


Figure 90 Before and After Rendering of Underground Walkway (Rendering prepared by Takao Ugai)

5.4 High-rise Residence Farming

5.4.1 Precedent: ARK Hills Executive Tower

Figure 91 ARK Hills Executive Tower (above: ground farming, right: roof top farming) (Photo by ARK hills)

ARK Hills Executive Tower is one of the most luxurious residence towers located in Roppongi, Tokyo (very dense high-end business district). It is part of ARK Hills, which is a cluster of buildings designed for people to live near their workplace and at the same time, coexist in the prosperous city, where the culture thrives. For more than two decades, it has grown and reintroduced a natural ecosystem in the city, enriching the urbanscape with the beauty of nature. In recognition of its contribution to the betterment of the urban environment through its mitigation of the urban heat island effect and community activities to green the city, ARK Hills was awarded the "National Energy Globe Award Japan" in 2006.[158]

158.Mori Building, "The Ark Hills Times," ARK Hills, http://www.arkhills.com/.

5.4.2 Site Description

City Tower Shinjuku New Urban Central（シティタワー新宿新都心）
(4-2-15 Shinjuku, Shinjuku Ward, Tokyo)

Figure 92 City Tower Shinjuku New Urban Central (Photo by Shibuheya Inc.)

City Tower Shinjuku New Urban Central is a 37 storey high class rental/ condominium apartment building that was built in 2005. Its rent ranges from $2,000 to $5,100 a month (currency exchange rate of $1.00=¥78 on September 17, 2012). The tower consists from one bedroom unit (400 sqft.) to three bedrooms (1,326 sqft.). There are varieties of common areas such as the large ground level lobby, 24 hour concierge service, complimentary guest rooms, lounge, party room, and laundry service. The majority of the residents are young couples and small families.

5.4.3 Opportunities and Constraints

Balcony farming is popular for high-rise residences; however, it depends on the azimuth orientation (Figure 93), and traditionally, Japanese people typically hang-dry their laundry on the balcony and so it will be necessary to give options for the residents. It is not so much common yet, but there are a lot of other potentials in high-rise residence farming. The best place to start is the rooftop garden. Typical high-rise condominiums in Japan are not utilizing the roof tops. Although it has areas with parapet guardrail, accessible stairs and water proofed floor, there is nothing but mechanical rooms. The best methodology to utilize the space would be the hydroponic agriculture, which is relatively light, and added structural reinforcement will not be required.

A typical high-end condominium has a large lobby with some amenity areas. These common areas could be more comfortable and appealing by integrating agriculture. Aeroponic is very attractive in terms of interior design, and that it is best suited for this purpose. Also, aquaponic could be utilized for a fish tank and displayed as an aquarium, and the colors and forms of plants and fishes should be considered in the selection process. If the lobby is large enough, a small scale of farmers market could be held. The residents could share their crops and trade or sell them. It would not only help them consume a variety of vegetables but also promote communication and strengthen their communities.

This is also an example of closed community farming. The plants and fishes are maintained by resident managers, and the residents seed, water, feed, clean and harvest by turn. Unlike individual farming, where people have to take responsibility in taking care of plants, this type of farming has less stress, and that if they could be away or go on a trip for a while, the farms could still be maintained. In order to prevent underwatering or overwatering of the plants, the residents must keep track of their activities in their common notebook or a computer system. In urban areas, especially in high-rise condominiums, they typically have tenuous relationship with their neighbors. The closed community farming will provide tighter knit community, more communication and interaction to people in Tokyo. Since they are paying about the same amount of rent or mortgage, their social status (or payroll) shall be somewhat similar. I believe that people with close economic circumstances tend to build a good relationship, and that all we need to do is to add these kinds of activities to create new healthy communities and enhance urban lifestyle.

Table 10 High-rise residence farming

Balcony	Administrator	N/A
	Participants	residents
	Methodology	potted plant
	Plants	varies
	Storage	unit kitchen/pantry
	Consumption	residents
Roof Top	Administrator	resident manager, outsourcing
	Participants	residents
	Methodology	hydroponic, aquaponic
	Plants	green beans, cabbage, cucumber, tomato
	Storage	storage in the building
	Consumption	residents
Indoor (Lobby)	Administrator	resident manager, outsourcing
	Participants	residents
	Methodology	aeroponic, aquaponic
	Plants	green beans, broccoli, cabbage, cucumber, lettuce, onions, tomato
	Fish	tilapia, trout, shrimp, crayfish, mussels
	Storage	storage in the building
	Consumption	residents

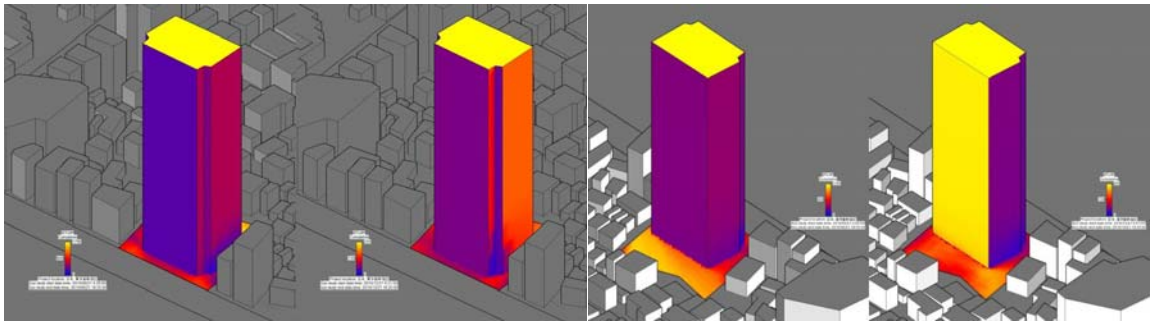


Figure 93 Solar radiation analysis of high-rise residence farming (left: summer solstice, right: winter solstice) (Image analyzed and rendered by Takao Ugai)

5.4.4 Adaptation Proposals

5.4.4.1 Balcony

As mentioned in Chapter 4.4 Balcony Farming, balcony farming is the easiest way to initiate the farming methodologies in urban areas. Potted plants are the most popular example. It does not require any type of structures, plumbing or architecture construction to implement it. All one has to do is to buy pots, soil and seeds and they can start farming right away.

With this particular proposal, multiple rods are placed along the handrails and gridded ceiling. Since there are many residents willing to hang-dry their laundry on their balcony, Two options are provided to choose from which utilize the same structure. Needless to mention, the two options can be combined as well.

The planters hanging from the ceiling are somewhat unique. This could be done by specifying the product called the Sky Planter. "Slo-Flo" internal irrigation feeds water from the ceramic reservoir directly into the roots without dripping (Figure 94). A webbed disc secures both plant and soil, so there is no mess.[159]

Figure 94 Sky Planter (Photo by Patra Beaulieu)

159. Patra Beaulieu, "Sky Planter Upside-Down Plant Pot," GeekAlerts, http://www.geekalerts.com/sky-planter-upside-down-plant-pot/.

Figure 95 Before and After Renderings of Balcony (Renderings prepared by Takao Ugai)

5.4.4.2 Rooftop

I strongly believe that rooftop areas of any types of buildings must be utilized more efficiently. For this residential tower, the recreation areas are placed along with hydroponic farming (Figure 97). There is existing access to the waterproofed rooftop, so that no structural improvement is necessary (Figure 96), except for a new plumbing system. A rainwater tank has been placed in order to reduce the water usage (which will be funded from monthly maintenance fee.) It cannot be made large enough, mainly due to some structural issues, to achieve net zero water usage, but it can still make contribution to conserving considerable amounts of water.

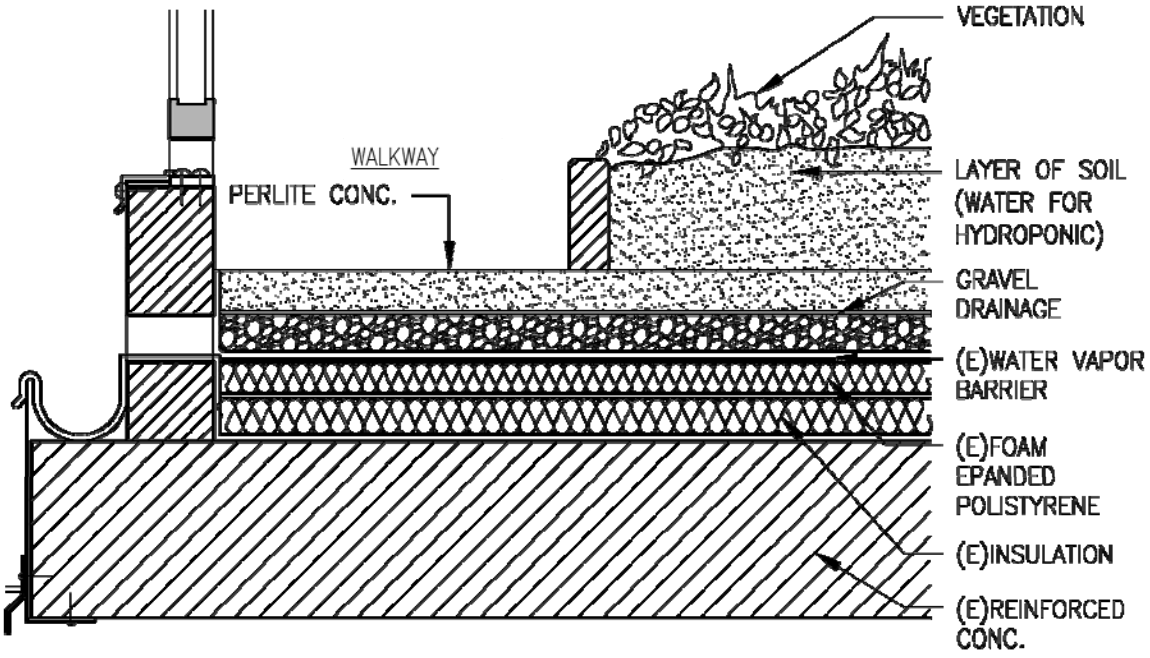


Figure 96 Detailed Section Drawing of Hydroponic Rooftop Farming (Drawing prepared by Takao Ugai)

Figure 97 Before and After Renderings of Rooftop Farming (Rendering prepared by Takao Ugai)

5.4.4.3 Indoor (lobby)

This lobby farming will give great impact to both employees and guests. The lobby is the face of the building, and people pass through the area at least twice a day as they enter and exit. There are people coming from different cities, prefecture or even foreign countries. I believe that lobby farming has plentiful possibilities to enjoy the benefits and methodologies of urban farming.

A moderate sized farmers market can also be held daily in the lobby. Unlike the ones in business farming or school farming, this farmers market are placed to be permanent, mainly because business buildings only open during the weekdays, and only a few vegetables would be offered that to be consumed on the same day. This way, people can enjoy the freshest possible vegetables on a daily basis, and moreover, they would not have to struggle getting on the busy trains and buses carrying multiple grocery bags. However, holding a farmers market everyday may increase the expense, so I decided to have no shop attendant. Unmanned grocery stores/stalls are actually quite popular in rural areas of Japan (Figure 98).

Figure 98 Unmanned Vegetable Stand (Photo by Ken Noguchi)

Figure 99 Before and After Renderings of Lobby Farming (Rendering prepared by Takao Ugai)

Section diagram of aeroponic farm along the wall and column is similar to Chapter 5.3 Underground Walkway Farming (Figure 89), and hydroponic farm on the ceiling is similar to Chapter 5.1 Business Farming (Figure 69).

5.5 Hotel Farming

5.5.1 Precedent: Hotel New Otani Tokyo

Figure 100 Hotel New Otani Tokyo (Photo by Hotel New Otani Tokyo)

Hotel New Otani Tokyo is located in the center of downtown Tokyo, with easy access to Ginza and Roppongi which are very popular, major shopping districts. It has a 400-year-old traditional Japanese garden, once home to samurai lord Kiyomasa Kato (1562-1611), and also owned by a "shogun" of the Edo period during its extensive history. Comprising 10 acres, including a moat, it is beautifully landscaped with trees, a koi fish pond, winding pathways, a Christian chapel, and even an impressive waterfall which attracts many guests. Because of these natural features, despite its metropolitan surroundings, Hotel New Otani Tokyo has had a very successful business.

5.5.2 Site Description

Shinjuku New City Hotel （新宿ニューシティホテル）
(4-31-1 Nishishinjuku, Shinjuku Ward, Tokyo)

Figure 101 Shinjuku New City Hotel
(Photo by Google Map on the left, Shinjuku New City Hotel on the right)

Shinjuku New City Hotel is called a “city hotel” but categorized under “business hotel.” The city hotels in Japan are generally expensive and considered high-end (like Sheraton or Hilton) which are normally located in busy downtown. Shinjuku New City Hotel is a business hotel which has inexpensive small rooms with convenient access to business districts. The hotel consists of 400 guest rooms that range from $80 to $160 per night (currency exchange rate of $1.00=¥78 on September 25, 2012).

5.5.3 Opportunities and Constraints

It might sound challenging to integrate the farming methodologies into a hotel, but there are some precedents and various hidden potentials. From the solar radiation analysis, there are not much wall spaces that are exposed to sunlight (Figure 102). Therefore, in this particular case, farming areas are limited to three roof tops and indoor farming in the lobby.

The basic agricultural methodologies are similar to the high-rise residence farming. Hydroponic will best suit the roof top farming. It will provide shaded open area, which will provide psychological healing effect to the guests. The guests are free to water, cultivate and harvest the plants by following the instructions displayed on site. In the same manner, either aeroponic or aquaponic will enhance the quality of the lobby's appearance. The presence of plants and various fishes will also make the area feel more welcoming and relaxing.

In order to maintain the farms, the hotel manager and employees' responsibilities are vital. They are not only required to check whether all of the plants and fish are well maintained, but also provide user friendly instructions by each farm, so that guests can easily take care of them correctly. However, the benefit of hotel farming could be remarkable. Since this hotel is business hotel, majorities of guests are staying for business purposes. The farm field features could relax these hard working business men and women in the middle of concrete jungle. These people are coming from all over the world, so that there is a great potential for spreading the ideas and benefits of urban farming through word of mouth. The hotel could also offer harvested organic food at their restaurants and through room service, which will appeal to many people and lead to revenue increase by higher sales.

Table 11 Hotel Farming

Roof Top	Administrator	hotel manager, outsourcing
	Participants	hotel guests
	Methodology	hydroponic
	Plants	cabbage, carrots, cucumber, lettuce, onions
	Storage	restaurant kitchen pantry
	Consumption	hotel employee, guests
Indoor (lobby)	Administrator	hotel manager, outsourcing
	Participants	hotel guests
	Methodology	aeroponic, aquaponic
	Plants	green beans, broccoli, cabbage, cucumber, tomato
	Fish	tilapia, trout, shrimp, crayfish, mussels
	Storage	restaurant kitchen pantry
	Consumption	hotel employee, guests

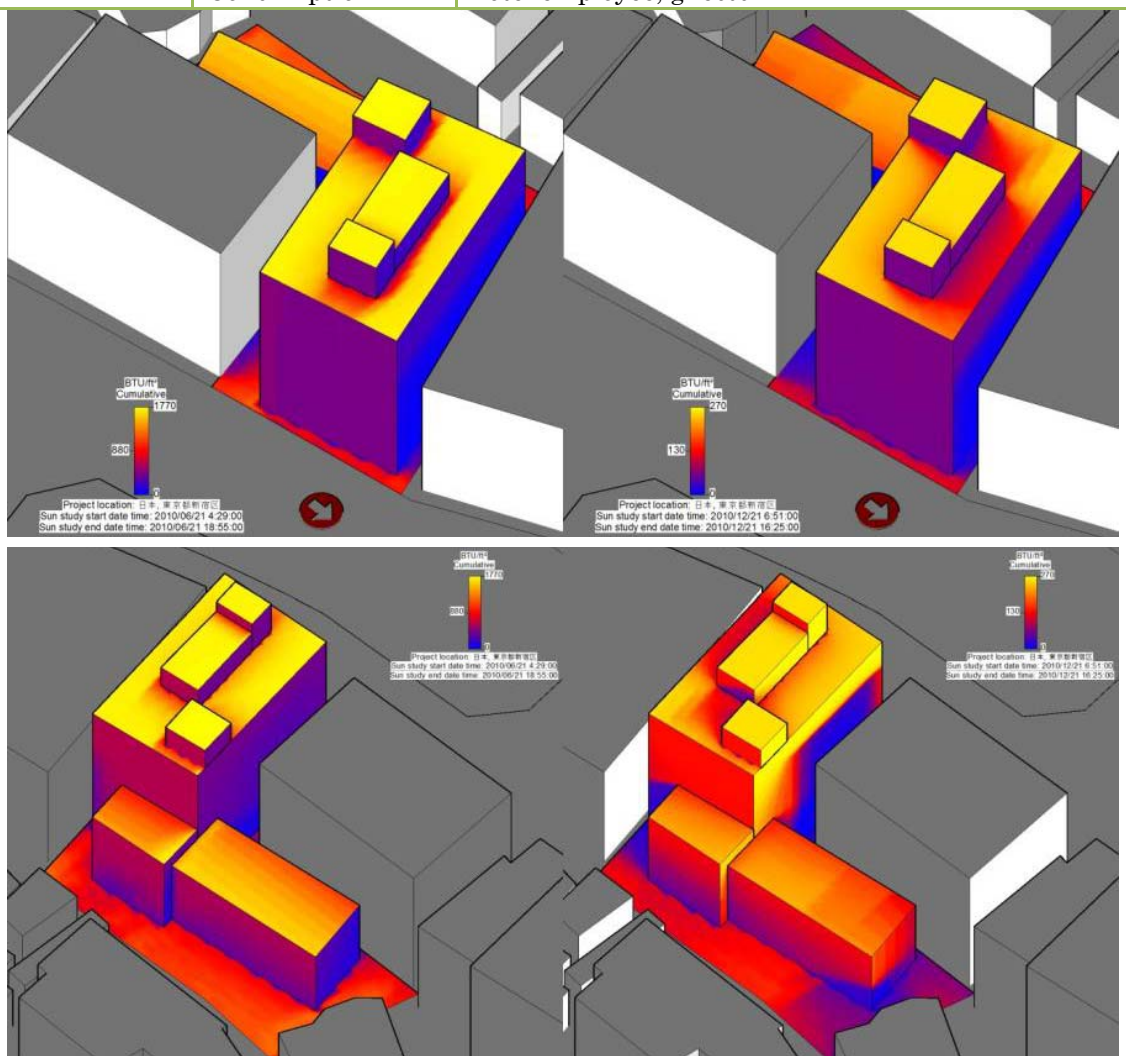


Figure 102 Solar radiation analysis of hotel farming (left: summer solstice, right: winter solstice)

(Image analyzed and rendered by Takao Ugai)

5.5.4 Adaptation Proposals

The hotel farming can be widely separated into two; rooftop and lobby farming. Two farming fields are very similar in terms of main purposes and the people involved. The major differences are the farming methodologies and the publicness.

5.5.4.1 Lobby

Similar to the business farming in the lobby, the lobby of the hotel is very important. It represents the concept of the hotel, and it should also offer some sense of welcome and relaxation. It is also open to public, and it is exposed not only to the employees and overnight guests, but also to the restaurant's patrons, random shoppers and visitors. It shall visually appeal to everyone by carefully selecting the plants and farming methodologies. Also, an easily comprehensible information board must be provided along the farm so that the guests can learn and participate in the farming process if they choose.

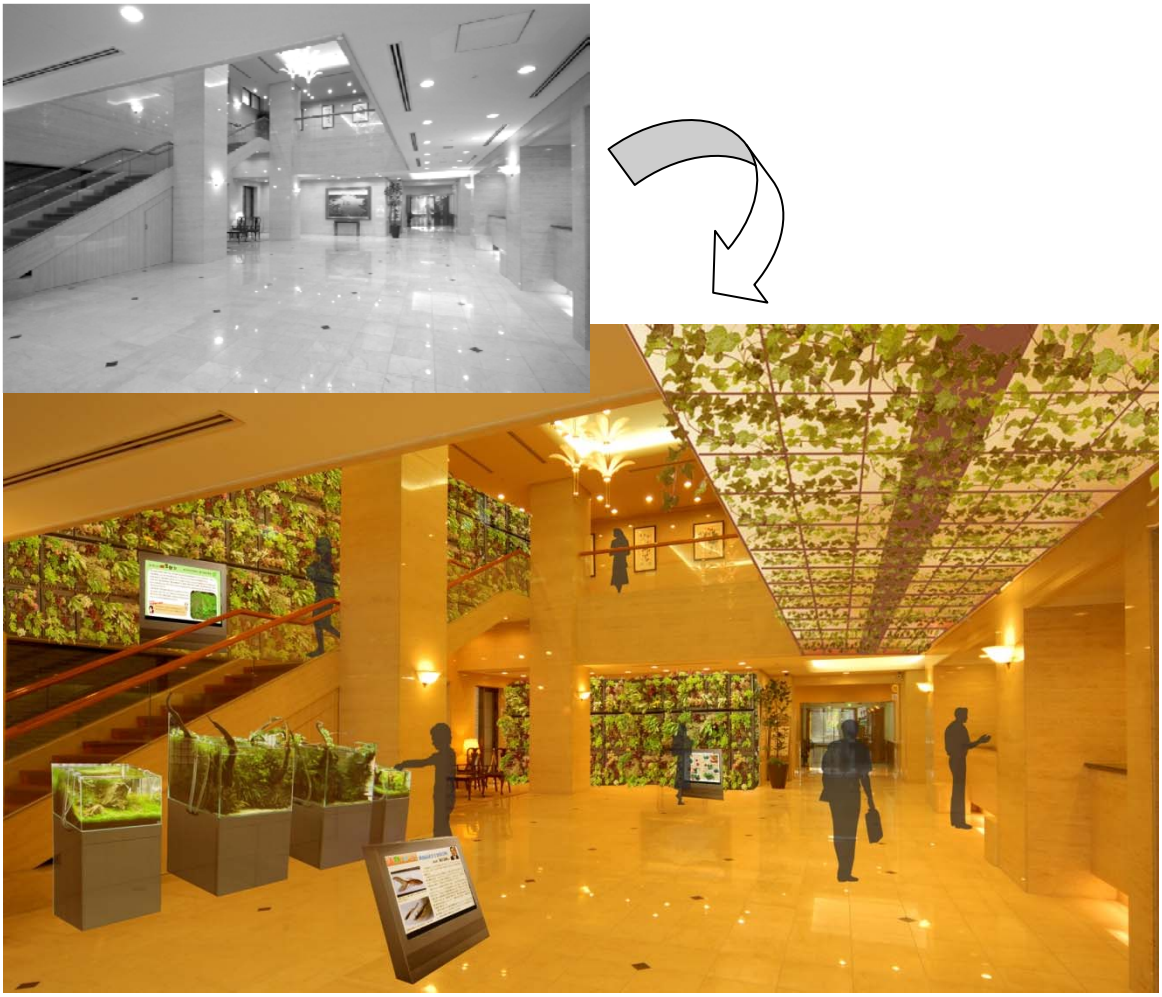


Figure 103 Before and After Renderings of Hotel Lobby Farming (Rendering prepared by Takao Ugai)

Section diagram of aeroponic farm along the wall and column is similar to Chapter 5.3 Underground Walkway Farming (Figure 89), and hydroponic farm on the ceiling is similar to Chapter 5.1 Business Farming (Figure 69).

5.5.4.2 Rooftop

The rooftop farming has less exposed or visible to public compared to the lobby. Since it is opened only to the hotel guests and employees, this space is made into an exclusive garden. Wide varieties of colorful plants are integrated to visually entertain the guests. The hydroponic systems are employed to minimize the dead load and also the burden of daily maintenance.

The harvested crops could be consumed on the site. A vegetable and fruit bar is placed to offer the freshest food and beverages. The remaining crops would be stored in the kitchen and served at the ground level restaurant and through room service.

Figure 104 Renderings of Hotel Rooftop Farming (Rendering prepared by Takao Ugai)

Section drawing of hydroponic rooftop farming is similar to Chapter 5.4 High-rise Residence Farming (Figure 96).

5.6 Government High-rise Farming

5.6.1 Site Description

Tokyo Metropolitan Government Building No.2 (東京都庁)
(2-8-1 Nishishinjuku, Shinjuku Ward, Tokyo)

Figure 105 Tokyo Metropolitan Government Buildings (Photo by Dakiny)

Tokyo Metropolitan Government Buildings were designed by Kenzo Tange in 1990. It houses the headquarters of the Tokyo Metropolitan Government, which governs not only the 23 wards, but also the cities, towns and villages that make up Tokyo as a whole. The building consists of a complex of three structures, each taking up a city block. Main Building No.2 has 37 stories including three below ground. Although it has not gained the same degree of worldwide recognition as Tokyo Tower, the Metropolitan Government Buildings have come to represent the city in its own right. It frequently appears in Japanese science fiction as a symbol of authority or, often, serving as the basis of type scenes depicting a futuristic or post-apocalyptic Shinjuku.

5.6.2 Opportunities and Constraints

Public high-rise farming is a combination of park farming and business farming. It involves advantages from both of the methodologies and has an essential role in the Cultivating Urbanism.

There are many occasions for citizens of Tokyo to visit Tokyo Metropolitan Government Building, such as issuing legal documents and certifications, paying taxes, or just sightseeing, since the penthouse is open to the public as an observation deck. Most of the citizens of Tokyo have visited the facility at least once in their lifetime, and it would be a great opportunity to introduce the benefits and methodologies of urban agriculture.

Also, it is a great location to investigate the advanced urban agriculture methodologies. The government could lend some portions of wall surfaces to the research institutes to innovate and test the new ideas like growing algae for energy generating purposes.

There are immense areas with high solar radiation that could be utilized as agriculture fields (Figure 106). The ground level should be carefully designed to integrate agriculture into landscape. One of the rooftops (highest one) has a helicopter platform for emergency use but other two could be utilized for green house hydroponic farming. All the rest of the areas, such as windows, indoor and exterior walls, should introduce as much agriculture fields as possible. It will create great opportunities for people to learn the importance, advantages and advanced technologies of urban agriculture.

Table 12 Public High-rise Farming

Ground	Administrator	Kogakuin University
	Participants	students from Kogakuin University, civil servants and volunteers
	Methodology	ground farming, horticulture
	Plants	wheat, pears, avocado, apple, cherry, lemon, etc.
	Storage	storage
	Consumption	civil servants, visitors and school lunch
Roof Top	Administrator	Kogakuin University
	Participants	students from Kogakuin University, civil servants and volunteers
	Methodology	hydroponic (green house)
	Plants	cabbage, carrots, cucumber, lettuce, onions, wheat
	Storage	storage
	Consumption	civil servants, visitors and school lunch
Window	Administrator	civil servants
	Participants	civil servants
	Methodology	hydroponic
	Plants	strawberries, lettuce, cherry tomatoes, peppers
	Storage	storage
	Consumption	civil servants, visitors and school lunch
Indoor	Administrator	Kogakuin University, civil servants
	Participants	students from Kogakuin University, civil servants
	Methodology	aeroponic
	Plants	asparagus, cucumber, tomato
	Storage	storage
	Consumption	civil servants, visitors and school lunch
Vertical Wall	Administrator	Kogakuin University
	Participants	students from Kogakuin University, civil servants and volunteers
	Methodology	module
	Plants	cucumber, potatoes, tomatoes
	Storage	storage
	Consumption	civil servants, visitors and school lunch

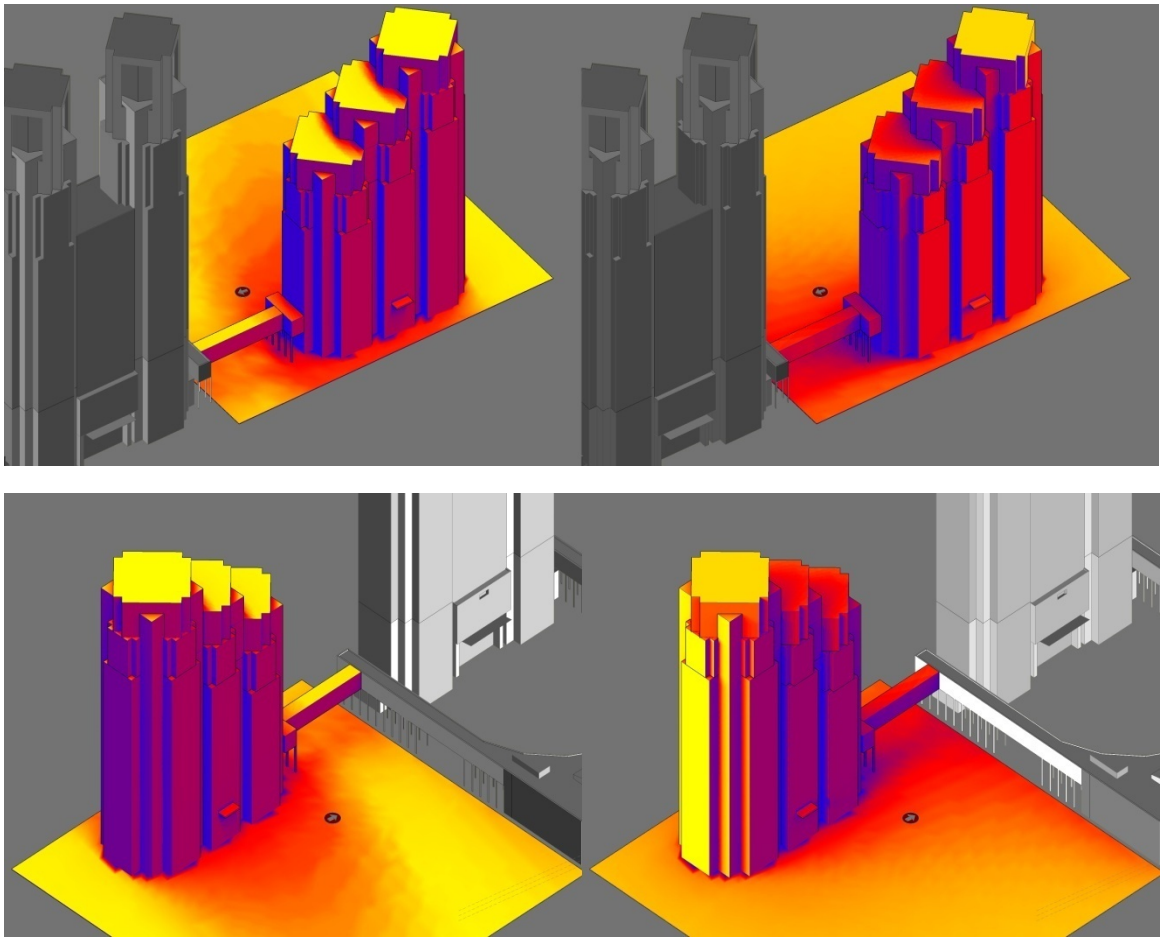


Figure 106 Solar radiation analysis of public high-rise farming (left: summer solstice, right: winter solstice) (Image analyzed and rendered by Takao Ugai)

5.6.3 Adaptation Proposals

The government farming could be largely divided into two segments: mix of community/business farming and research farming. These farming locations have two different purposes. The former one is aimed to introduce the benefits and methodologies of urban agriculture, generate the opportunities for citizen to mingle with civil servant (which tends to have bad impression in time of recession), and mass-produce the vegetables to serve. The research farming will be managed by Urban Agriculture Department in Kogakuin University, and it is aim to maximize the use of the space and make the contribution towards the development of new technologies and educations.

5.6.3.1 Ground Level

The agricultural field on the ground level will be community/business farming. It has maximum exposure to public with great accessibility. In order to introduce the farming method and educate the people, the information boards are placed in front or by the side of agricultural fields. It includes installation instructions, precaution statement, and the benefits to the people's life style. A variety of farming methodologies are introduced to attract people's attention.

Figure 107 Before and After Renderings of Ground Level Government Farming

(Rendering prepared by Takao Ugai)

Section diagram of aeroponic farm along the walls and columns is similar to Chapter 5.3 Underground Walkway Farming (Figure 89), and ceiling planters are Sky Planter (Figure 94).

5.6.3.2 Indoor, Rooftop, and Exterior Wall.

The research farmings are located inside the building, on the rooftop, and along the exterior walls. These areas are not open to public due to security and life safety issues. However, there is a vast vacant area that could be utilized. Many researches and educations could be pursued in these areas; such as efficient indoor farming, efficient lighting systems, wind countermeasure on the rooftop (Figure 108), and massive algae farming along the exterior wall for example (Figure 109). It will not only aid to rise additional funding for the Tokyo Government to pay off its dept, but also contribute to the local society and economy. The Urban Agricultural Department in Kogakuin University will grant the open space inside the building for the education and research purposes, and in return, they will be responsible for maintaining the healthy communities and farmlands.

Figure 108 Rendering of Rooftop Government Farming (Rendering prepared by Takao Ugai)

Figure 109 Algae Farming along the Exterior Wall (Rendering prepared by Takao Ugai)

5.7 Park Farming

5.7.1 Precedent: Shah Alam Malaysia Agriculture Park

Figure 110 Shah Alam Malaysia Agriculture Park (Photo by Gsy Donkey)

Shah Alam Malaysia Agriculture Park is located in Shah Alam, Malaysia. This 1,295 hectare of tropical rain forest and agricultural park is one of the largest in the world. The main objective of the park is to serve as a permanent exhibition centre for the development and progress of agriculture in the country. It also aims to act as a referral and research centre for the various fields of agriculture such as farming, animal husbandry and fish rearing.[160]

160. TourMalaysia, "Malaysia Agriculture Park," impressions.com, http://www.impressions.com.my/agro/masagro/masagro.htm.

5.7.2 Site Description

Shinjuku Central Park （新宿中央公園）
(2-11 Nishishinjuku, Shinjuku Ward, Tokyo)

Figure 111 Shinjuku Central Park (Photo by Jay Dee)

Shinjuku Central Park is a small green area in western Shinjuku, Nishi-Shinjuku, 2-chome, Tokyo, Japan. The park is bordered by Honnnan Dori or Kita Dori to the north, Junisha Dori to the west, Suido Dori or Minami Dori to the south, and Koen Dori to the east. The park is surrounded by some of Tokyo's tallest buildings, including the Tokyo Metropolitan Government Buildings 1 and 2, Hyatt Regency Tokyo, the Park Hyatt, and other hotels and office buildings.

The layout of the park is very simple. It is a very accessible park for many office workers in the area and an ideal place for them to spend their lunch time. You can also see the belongings of homeless people wrapped up in blue plastic sheets ready to be unpacked at night time.

Shinjuku Central Park is different from Shinjuku Imperial Gardens, also known as Shinjuku Gyoen, located on the south-eastern side of Shinjuku Station.

5.7.3 Opportunities and Constraints

The public park rules very important factors in urban situations. It not only provides psychological and emotional relief to people but also cleanses the air; however, in Shinjuku Central Park, there are many tents and temporary housing built by the homeless, and the crime rate is relatively high. By establishing more functions and communities in the park, we could reduce the number of crimes and enhance the function and quality of the space. In the Cultivating Urbanism, the park performs as a community garden, agricultural information booth, community vermin-composting (composting through worm culture) and advanced horticulture for future technologies. It becomes a node for agricultural communities, and local people will visit to ask technical questions, exchange information and buy or sell goods. In Shinjuku Central Park, there is Eco-gallery Shinjuku, which is already functioning as an ecological information center. The facility could be better utilized by concentrating on agricultural features and act as the core of the agricultural communities node. The people working at Eco-gallery Shinjuku are civil servants and private researchers. Their main roles are investigating horticulture, assembling volunteers for maintaining the farm, organizing agricultural communities, assembling food scraps, distributing nutritious soils, and providing agricultural information to the community.

The farming methodology is mainly conventional ground farming. The plants that are more suitable for ground farming rather than hydroponics or aeroponics system shall be harvested much like wheat. In addition, physical appearance is crucial to the park farming. There are vast open areas (Figure 112), and the public parks have a variety of urban functions which cannot be disregarded. It should be welcoming, relaxing, refreshing and attractive. Creating an attractive park landscape could be achieved by carefully designing the area with colorful plants and trees. The harvested crops will be collected and sold in the park or distributed to the local schools.

Table 13 Park farming

Ground	Administrator	Kogakuin University
	Participants	students from Kogakuin University & volunteers
	Methodology	ground farming, aquaponic, vermiculture
	Plants	wheat, pears, avocado, apple, cherry, lemon, etc.
	Storage	Eco-gallery Shinjuku
	Consumption	sold at Eco-gallery Shinjuku, school lunch

The potentials of park farming could be seen in larger scales. The most striking features of Cultivating Urbanism are combinations and interactions between multiple farming locations. It will maximize the benefits by functioning in whole and create new social communities in urban situations. The park farming will be the key feature to stimulate the people to initiate and appreciate urban farming.

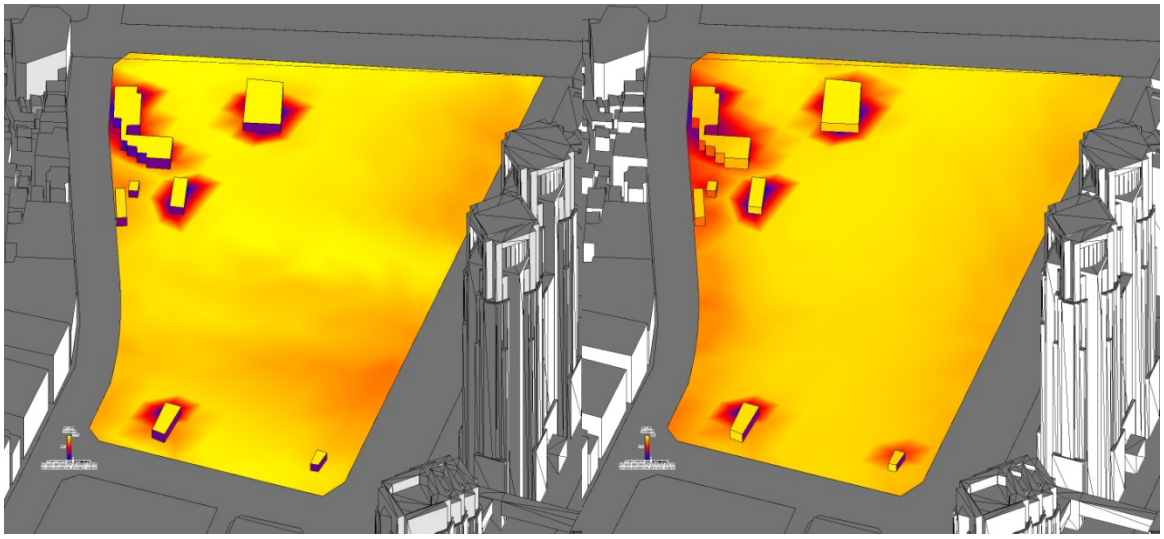


Figure 112 Solar radiation analysis of park farming (left: summer solstice, right: winter solstice) (Image analyzed and rendered by Takao Ugai)

I analyzed the current circulation diagram of the site. The major traffic comes from Shinjuku Station to business and civic buildings (Figure 113). The majority of the residents living on the west side of the site walk straight to the nearest station, which is surrounded by local stores and supermarkets, and come back to their home. The park is located between the residential and business districts, so that there is no cross traffic through the park.

In order to have local residents and business workers come over and utilize the park, more attractive and functional elements are desired. By creating more reasons and opportunities to visit, the park will become a node and can be utilized more actively and frequently (Figure 114).

The Urban Agricultural Department in Kogauin University will grant the open space for the education and research purposes, and in return, they will be responsible for maintaining the healthy communities and farmlands.

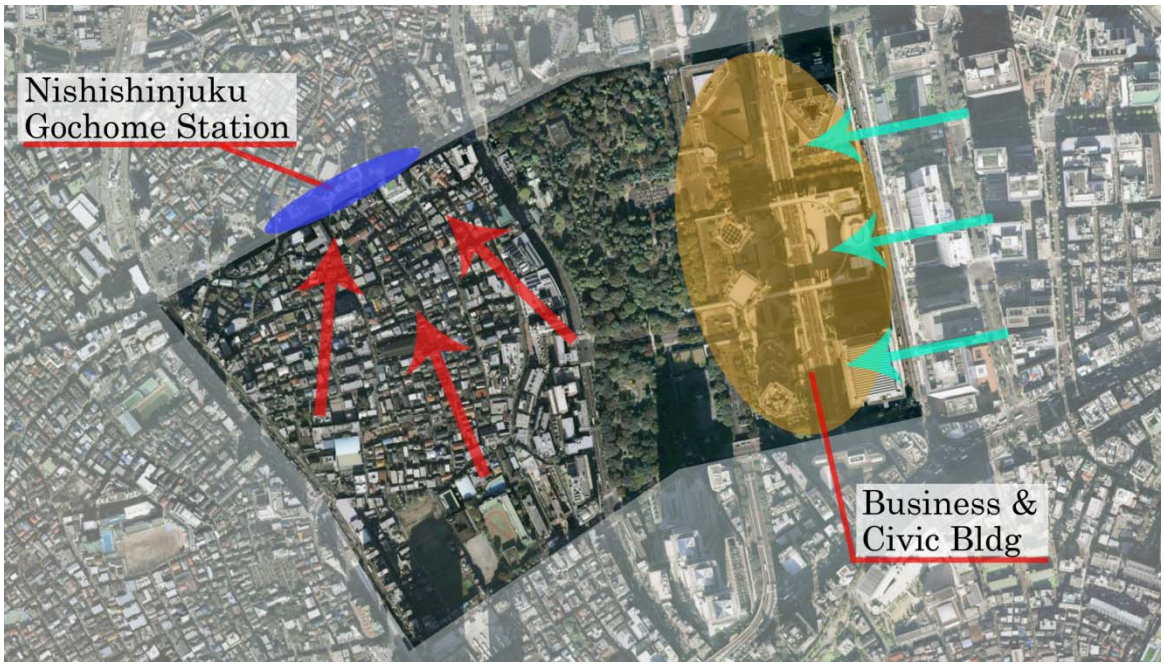


Figure 113 Current Circulation Diagram (Diagram prepared by Takao Ugai)

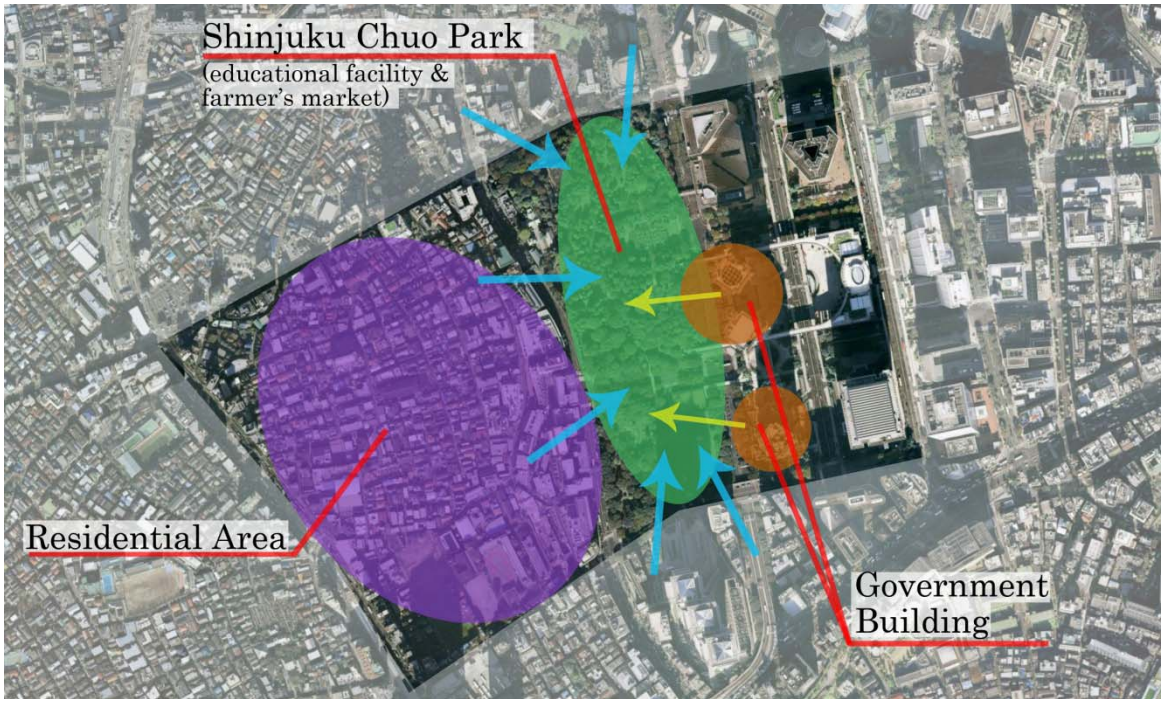


Figure 114 Proposed New Nodes and Circulation Diagram (Diagram prepared by Takao Ugai)

5.7.4 Adaptation Proposals

In order for the park to attract more visitors and become an urban node, several new functions are added. There are also several existing facilities that could be preserved and utilized much more by adapting agricultural field.

Eco Gallery Shinjuku is located on the northwest side of the park (Figure 115). It is the facility that educates and introduces environmental friendly products. I think the intentions of this building are very interesting and worthwhile that they deserve more acknowledgement. In order to achieve more recognition, vermiculture and community farming along with farmers market are adapted (Figure 118). That way, people would come by frequently to drop off their solid wastes, pick up the fertilizers, take care of the community farm and buy or sell the vegetables. It will not only create active and tighter-knit communities but also actualize the full food chain cycle.

In the middle of the park, there is the beautiful Shinjuku Niagara Falls which is a famous spot for shooting photos and movies (Figure 116). The waterfall is so widely known and admired by many that it shall be preserved. A couple of aquacultures are adapted nearby since the modification will be very easy due to the existing waterlines.

Figure 115 Eco Gallery Shinjuku
(Photo by SimCOSlab)

Figure 116 Shinjuku Niagara Falls
(Photo by Shige Crane)

The lower part of the park is designated for young people and children. There are an athletic field and a playground. This area of the park is very well utilized and always crowded with young children. On the other hand, its surrounding areas are occupied by a number of homeless people, and that has been a concern for the parents. There is a historical background for this homeless issue of this park. When the underground

walkway was built in 1996, the homeless people who were sleeping in the area were forced to leave and move into this park. Since then, their living there has not been questioned, perhaps purposely, without better so lutrins. Fortunately, there has been no notable crime committed by the homeless people within the property, but the statistic fact does not free the parents from being cautious none the less. Not only to solve this issue but also to efficiently utilize the area, educational farming is adapted along the play ground. The parents will feel safer by having more people around, involved in activities, and kids will also enjoy more opportunities to learn about agriculture.

Figure 117 Kids Play Ground (Photos by Wansan2)

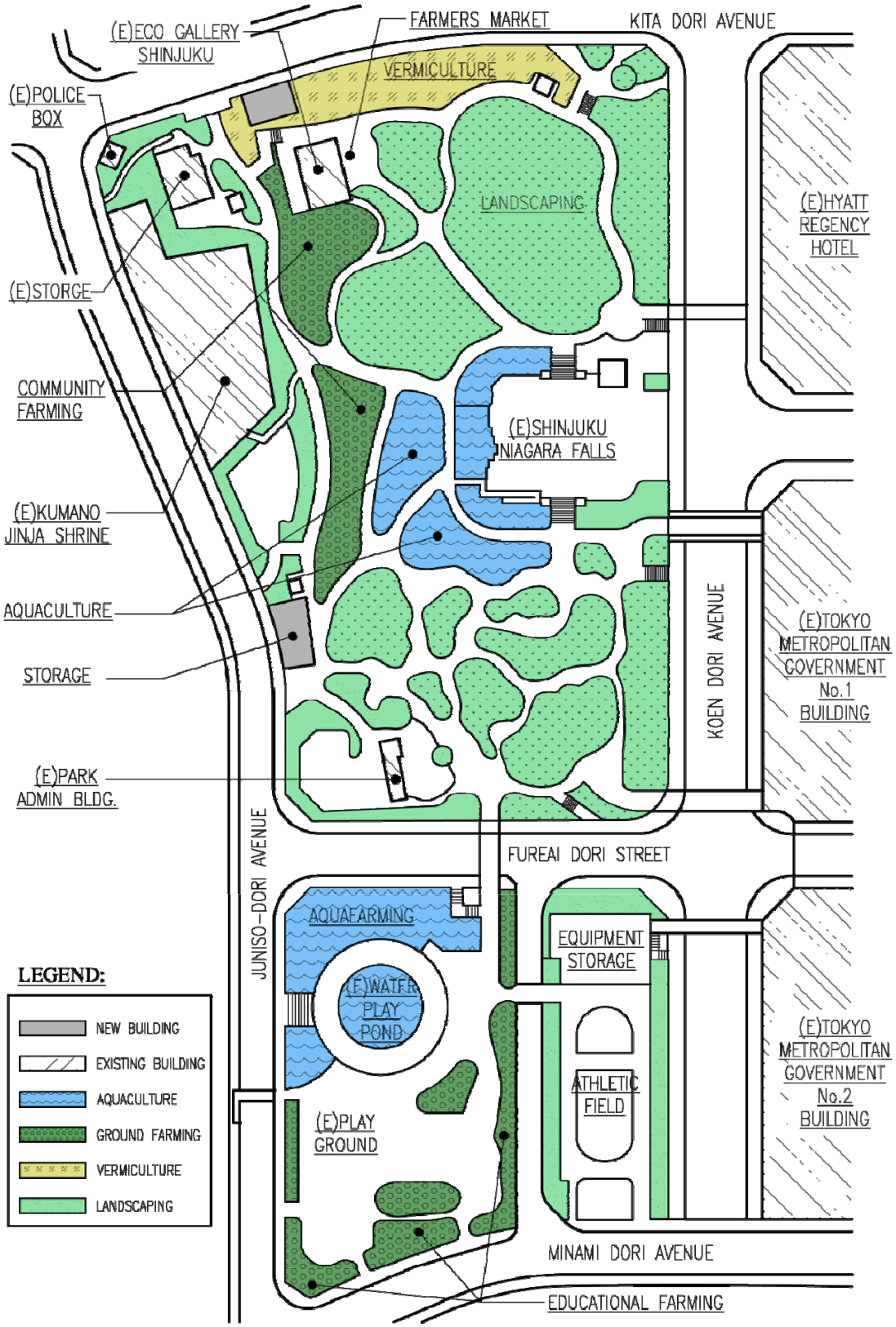


Figure 118 Proposed Site Plan of Park Farming (Diagram prepared by Takao Ugai)

5.8 Low-rise Residence Farming

5.8.1 Precedent:

Figure 119 Villa Bio
(Photo by arch daily)

Villa Bio in Barcelona, Spain was designed by Enric Ruiz-Geli's firm called Cloud 9. This modern concrete architecture has a floor-to-ceiling window that caps the end. The most interesting feature about this residence is that there are no internal beams supporting the concrete inside the home, even with the green roof on top. The strategy is very simple. The green roof is a hydroponic garden, which is very light and normally does not require much structural reinforcement.

5.8.2 Site Description

3-storey private residence

Figure 120 3-storey Private Residence (Photo by Google Map)

This 3-storey private residence has been chosen as an example due to its contemporary design. It is a small and narrow 2 bedroom house with an enclosed garage. There are two large balconies that are partially used to hang-dry the laundry. The house was designed for a couple with one child with ample space to be utilized and maximize the benefit of urban farming.

5.8.3 Opportunities and Constraints

Residential districts in Tokyo are very dense that most of the residences have little or no yard within their property. It is necessary to incorporate an advanced urban farming methodology to harvest a reasonable amount of crops at home.

Many people living in single family homes enjoy balcony farming, but as stated in Chapter 5.4 High-rise Residence Farming, hang-drying laundry outside is very common in Japan, so that a comfortable and cohesive way to incorporate the two separate functions must be invented.

Modern style residences have more potential for urban agriculture. Typically, they have large windows and flat roof tops that could be used for farming (Figure 121). Many people believe that farming requires a lot of effort to maintain, and plants are very delicate that they would wither easily, but it is not necessarily true. If only adequate information can be provided to people, it is possible to make them realize just how feasible it is to incorporate farming into their daily lives. Additionally, it is very important for people to have easy access to necessary farming materials. There are many pre-engineered products in the market that offers advanced agricultural methodologies which can be easily adapted; such as window farming, roof top farming and even vertical farming.

Table 14 Low-rise residence farming

Roof Top/ Vertical	Administrator	residents
	Participants	residents
	Methodology	hydroponic
	Plants	cabbage, carrots, cucumber, onions, tomatoes
	Storage	pantry
	Consumption	residents
Indoor/ Window	Administrator	residents
	Participants	residents
	Methodology	module, wall climbing, hydroponic
	Plants	cucumber, potatoes, tomatoes
	Storage	pantry
	Consumption	residents

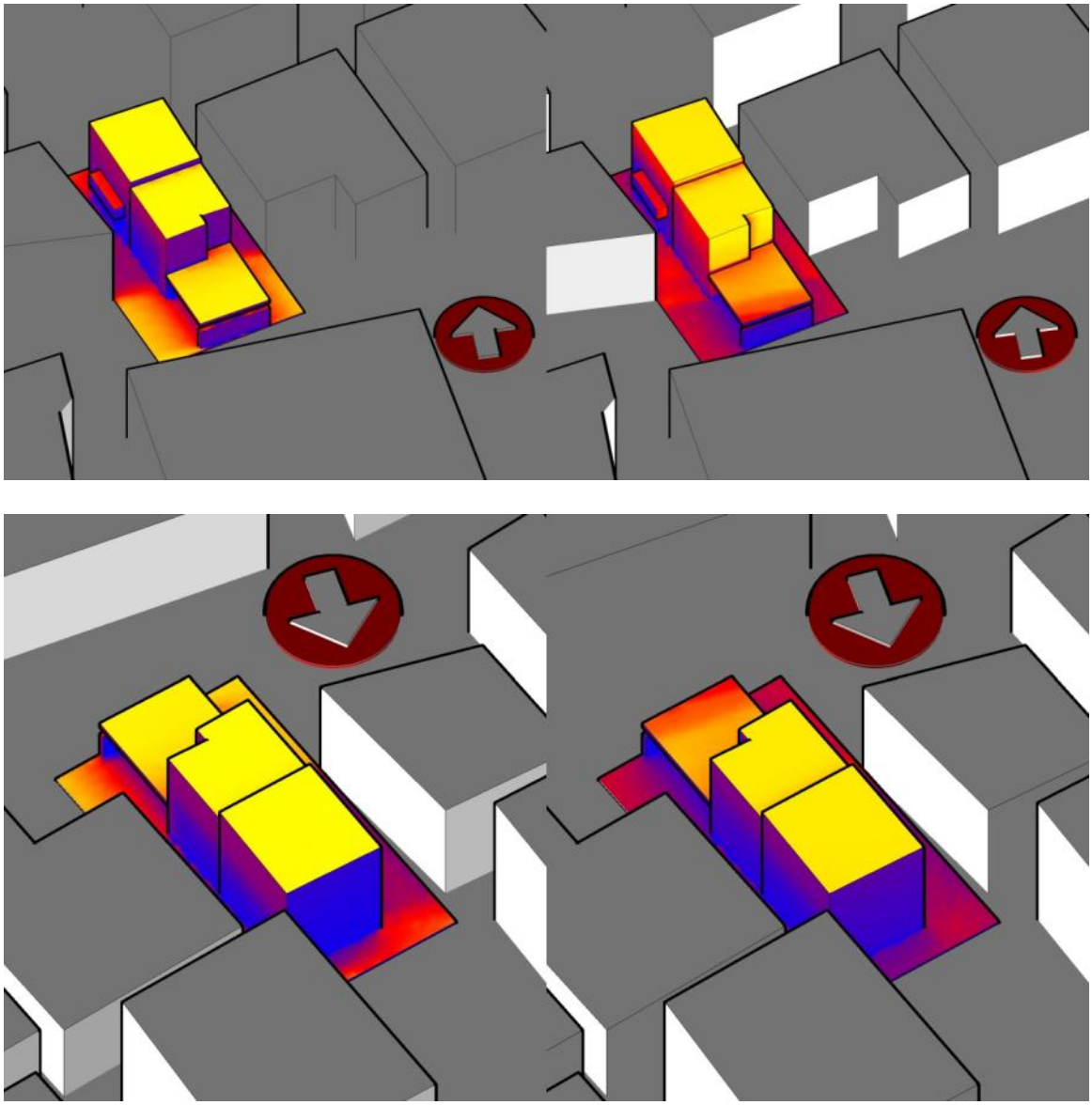
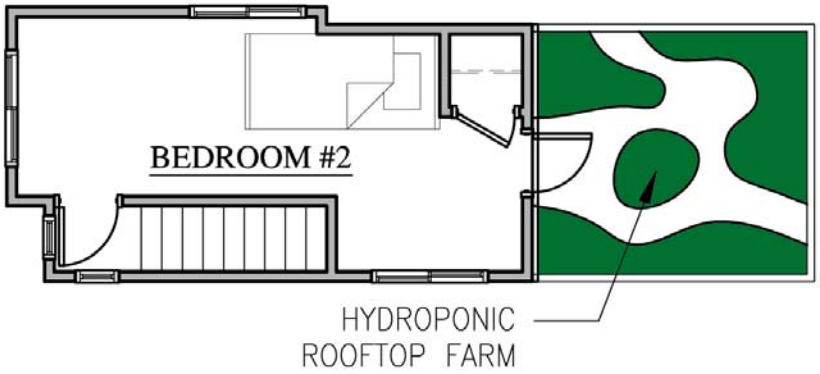


Figure 121 Solar radiation analysis of low-rise residence farming (left: summer solstice, right: winter solstice) (Image analyzed and rendered by Takao Ugai)

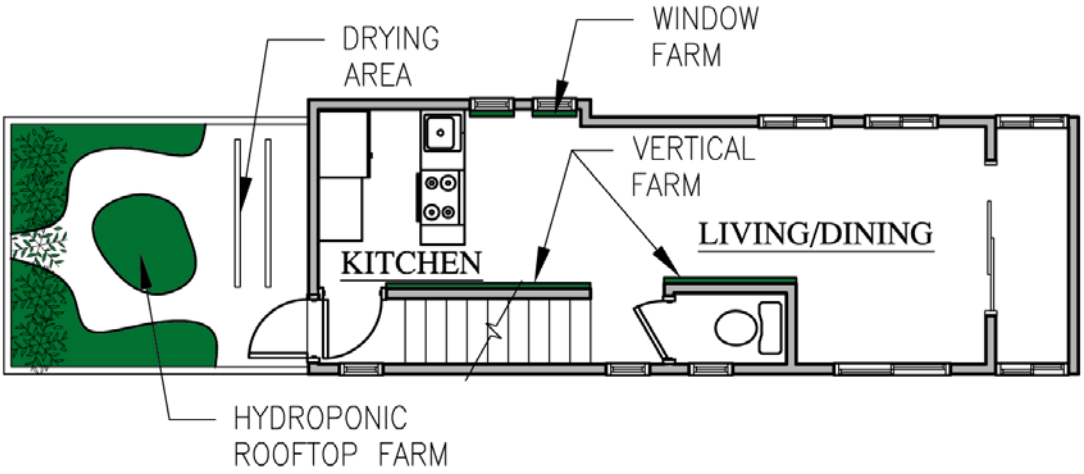
5.8.4 Adaptation Proposals

The residence that is selected to investigate has two large flat rooftops. There is enough space for the residents to grow plants without sacrificing an area to dry their laundry. The laundry area and hydroponic farm can coexist on the second and third floor rooftops. Indoor vertical farming and window farming are introduced to the second floor as well (Figure 122). The second floor best suits the indoor farming because it is the prime common area with living room, dining and kitchen. Typically, people spend the majority of their time in these areas, so that the farm is always visible and can be accessed with ease.

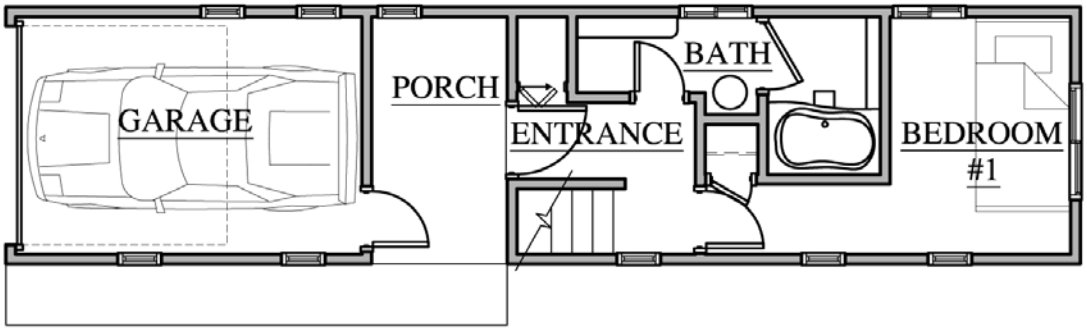
There are many benefits for growing food at home. If there are small children in the family, they can be naturally and intensively educated about food (see Chapter 2.2.2 Dietary issues and "Shokuiku": food and nutrition education, for details). Furthermore, we tend to develop more appreciation for things that we grown on our own, and the food seems to taste better. Family will have more communication and enjoy quality time through working together on the farm. Residence farming can develop strong ties within the family members.



THIRD FLOOR PLAN



SECOND FLOOR PLAN



GROUND FLOOR PLAN

Figure 122 Proposal Floor Plans of Low-rise Residence Farming (Diagram prepared by Takao Ugai)

5.8.4.1 Indoor

It may seem challenging to integrate indoor farming into a private residence. People may be concerned about the issues related to bugs, moisture, initial constructions, and ongoing maintenance; however, placing simple foliage plants in the house is quite common. If an appropriate methodology can be selected, there is not much difference between farming and growing a potted plant, except for the fact that you can harvest crops. Window farming requires minimum cost and labors as stated in Chapter 4.3 Window Farming. If the residents can afford the initial construction cost, hydroponic vertical walls can be integrated for more crops, visual impact and to achieve positive psychological effects (Figure 123).

Figure 123 Before and After Renderings of Low-Rise Residence Indoor Farming

(Rendering prepared by Takao Ugai)

The section diagram of the wall farming is similar to business farming (Figure 70).

5.8.4.2 Rooftop/Vertical Wall

Almost all of the residences in Tokyo have balconies. The balconies are best suited for farming, because it is typically designed to face as close to south as possible to maximize the sun exposure. Hydroponic rooftop farming is specified to minimize the dead load. The layout is determined with accessibility in mind. The farm is divided into sections so that a variety of plants can be harvested without having to worry about compatibility.

If there is only limited balcony space available, the similar methodology of balcony farming in high-rise residence could be employed (Chapter 5.4.4.1 Balcony).

Figure 124 Before and After Renderings of Low-rise Residence Rooftop Farming

(Rendering prepared by Takao Ugai)

The section diagram of the rooftop farming is similar to the high-rise residence farming (Figure 96).

5.9 Restaurant Farming

5.9.1 Precedent: Roppongi Farm

Figure 125 Roppongi Farm (Photo by SoulVillage STATION)

Roppongi Farm is a restaurant located in the core of an urban district called Roppongi in Tokyo. Roppongi Farm is effectively integrating farming into their operation. They hold various farming events, where customers can participate and learn how the ingredients are delivered, not from the kitchen but all the way from the soil. They believe that, by showing the entire process of "farm to table" and practicing transparency, they can satisfy their customers' palate and curiosity. As shown in the picture above, the farms are showcased in such a fashion that it is visually very appealing. All of the plants are organic, and the restaurant is promoting safe and healthy slow food, while projecting the trendy image.

5.9.2 Site Description

Caffè in Hyatt Regency Tokyo (2-7-2 Nishi-Shinjuku, Shinjuku Ward, Tokyo)

Figure 126 Caffè (top: exterior view, bottom: interior view) (Photo by Hyatt Regency Tokyo)

Caffè is a high-end restaurant located on the second floor of the Hyatt Regency Tokyo. They serve Italian food prepared in the show kitchen's distinctive Rotisserie and Teppan Grill.[161] The interior space is well designed with natural wood texture and moody indirect lightings, enhancing the quality of the space.

161."Hyatt Regency Tokyo," Hyatt Corporation, http://tokyo.regency.hyatt.com/hyatt/hotels-tokyo-regency/entertainment/dining_detail.jsp?itemDesc=fboutlet&itemId=1000027.

5.9.3 Opportunities and Constraints

Restaurants are directly connected to farming. Integrating the urban farming methodologies into restaurants will enhance the image and actual quality of healthy and fresh foods.

Most of the restaurants in Tokyo are in mix-use buildings with no garden or rooftop access. The only but effective way to integrate urban agriculture, in this situation, is indoor farming. The farm can be seen and accessed by the customers very easily, so that it can be an important part of the visual concept of the restaurant and also create another activity in the facility. Diners can enjoy the option to choose not only from the menus but also from the agricultural field. Customers can directly harvest vegetables of their choice and hand them to the chef to cook for them. Customers are also allowed to take care of unharvested vegetables. By providing more reasons for customers to visit more frequently, the restaurant can build a faithful repeat a clientele and establish deeper relationship with them, which ultimately leads to more profit as well.

Table 15 Restaurant Farming

Indoor	Administrator	restaurant owner, chef, outsourcing
	Participants	customer, employees
	Methodology	aeroponic
	Plants	asparagus, cucumber, tomato, onion, herbs
	Storage	kitchen pantry
	Consumption	customer

5.9.4 Adaptation Proposal

Safe and quality food is the lifeline of any successful restaurant business. It only makes sense to harvest the vegetables at the place where they serve them. To make this possible, very delicate design decisions must be made to avoid unforeseen incidents. This existing location I have selected has minimum natural light with only few artificial lighting. The selection of plants has to be very carefully done with these severe conditions in mind. Also, the plants are placed away from the seating area, because falling leaves or crops on the food or table can ruin a meal.

In addition to considering these challenges, the visual attractiveness of the interior decoration is maximized by selecting the large leaf plants placed on the vertical grid system (Figure 127).

Figure 127 Before and After Renderings of Restaurant Farming (Rendering prepared by Takao Ugai)

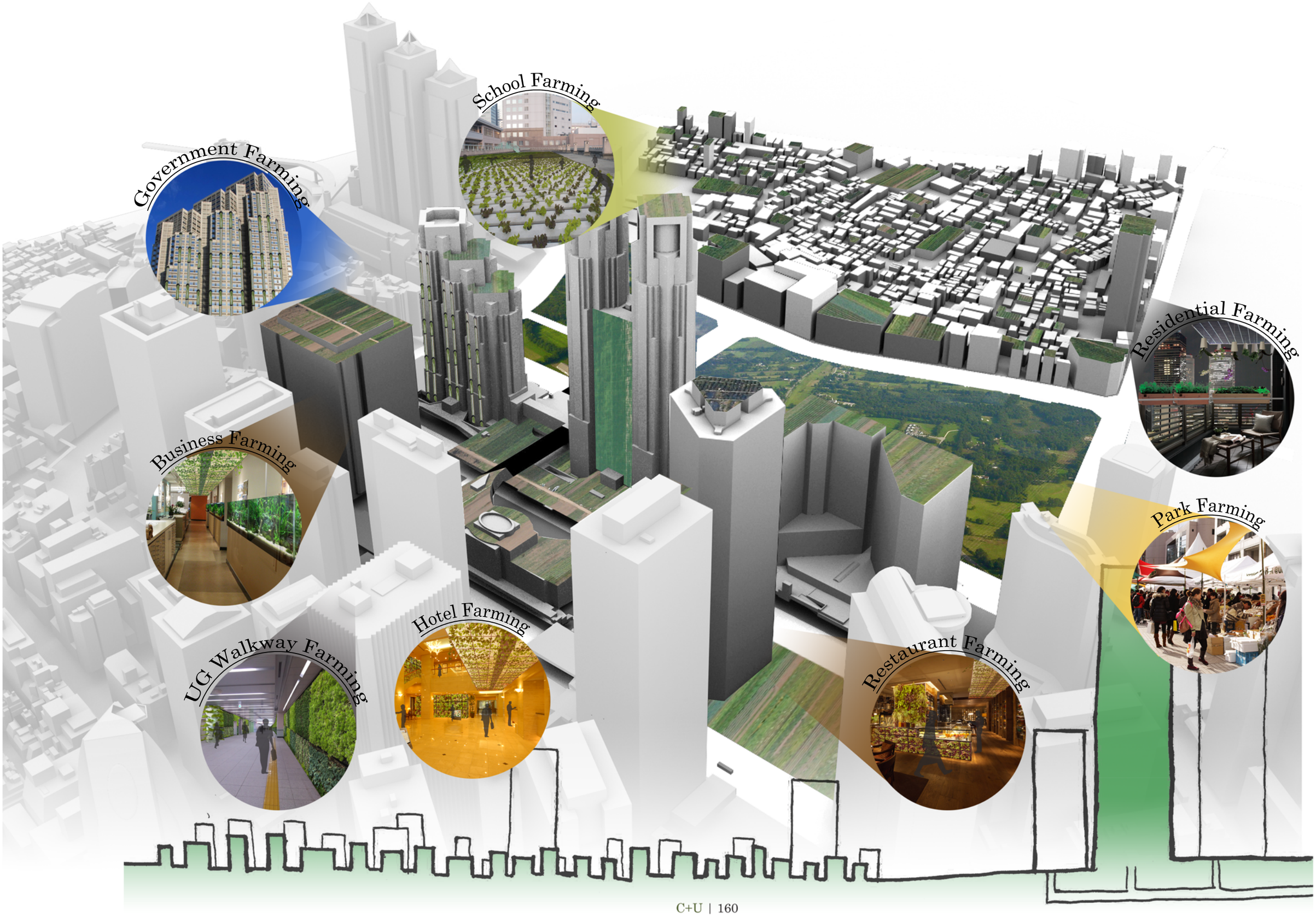
6. Conclusion

Cities and farmlands were considered mutually exclusive identities and were supposed to exist separately. From deep in the past, cities have consisted of governmental, financial, and distributional centers. It has always been better to be densely packed-together to minimize the transit, which leads the surge of land value. On the other hand, farmland requires vast amount of land to maximize the profit per capita. Both areas complemented each other by exchanging resources, but they had to be widely separated due to its different demands. We have always considered the importance of rural areas as much as urban areas based mainly on the food production demands. Many rural areas are occupied by agriculture land and contaminated with pesticides. The harvested crops travel hundreds of miles into the cities leaving enormous amount of carbon footprints. At the same time, urban areas are suffering from issues caused by deficiency of green (agricultural) areas; such as heat island effect, stormwater runoff, food security, solid waste, and natural-deficit disorder. However, human beings naturally and instinctively feel the need for "green" environment, as we can see in the form of parks, community farms and even home gardening. I do believe that our fundamental desire to coexist with nature must be paid attention to and can be fulfilled in logical and harmonious ways.

In this doctorate project, I propose, what I would like to call, "Cultivating Urbanism." This is a proposition of urban fabric that transforms an existing city through agrarian interventions. Current technologies enable us to adapt agricultural fields to wide varieties of architectural elements; such as interior/exterior wall, floor, handrail, ceiling, rooftop, column, and window. By adapting these agricultural/architectural methodologies, many issues in urban situation could be mitigated. Not only that, depending on the use of the building, many social benefits could be found as well. There is much potential for enhancing visual appearance, providing recreational space, generating communities, branding private firms, educating people, and researching advanced technologies.

The studies of this project focused on Shinjuku, Tokyo, because it seems to be in extreme condition in terms of high food dependency rate and limited green areas. I chose Shinjuku, among many other major cities such as New York, Los Angeles, Shanghai, or Sydney, as the model city to showcase the new form of urban fabric, which is the primordial of this proposition. Each of these major cities just mentioned has its own

latent possibilities and issues when we try to transform them, and that I think there is definite potential to explore and investigate more large cities to consolidate the fundamental ideas of Cultivating Urbanism. I trust that many residents and workers in the major metropolitan areas will also find my ideas and theories instinctively fascinating and something that commands their attention. I would like to continue my studies on Cultivating Urbanism and share the ideas with the world with infinite hopes to create more sound and effectively functional future for us all.


School Farming
Government Farming
Residential Farming
Business Farming
Park Farming
UG Walkway Farming
Hotel Farming
Restaurant Farming

Appendix A: Greater Site Analysis

This doctorate project focuses on study in specific site, Shinjuku, Tokyo. The site analysis in this thesis discusses the general information about the site, climate analysis, and the land use. It is crucial to consider macro and micro climates of the site in order to harvest the plants in an urban area.

General Information of Shinjuku

The site that this research focus on is located in Shinjuku (新宿区 Shinjuku-ku), which is one of the 23 special wards of Tokyo, Japan. According to the Shinjuku ward office, in March, 2011, total number of housing is 171,377, total population is 318,982 people including 35,266 foreign people.[162] More than 10% of the residents are from another country which is the largest percentage of the 23 special words of Tokyo. The total area of Shinjuku is 18.23 km^2 (7 sq mi)[163] and average density is 17,460/km^2 (45,221.2/sq mi). The Shinjuku Station is the busiest train station in the world and is used by over 2.5 million people per day. There are 11 different rail services and over 50 different buses stop at the terminals. With a massive underground arcade, there are over 200 exits in the station.

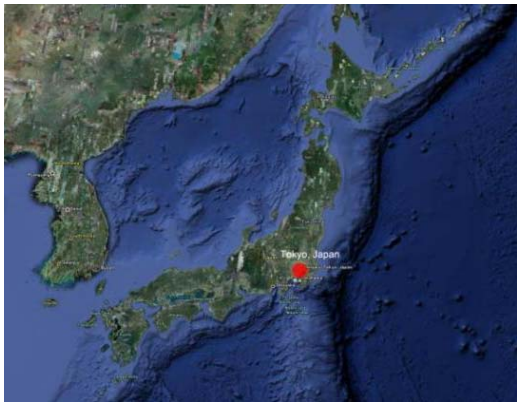


Figure 129 Map of Japan (prepared by Takao Ugai based on map exported from Google Earth)

Figure 128 Map of Tokyo (prepared by Takao Ugai based on map exported from Google Earth)

162. Shinjuku Ward Office, "Population of Shinjuku City," Shinjuku City, http://www.city.shinjuku.lg.jp/kusei/index02_101.html.

163. ———, "Description of Shinjuku," Shinjuku City, http://www.city.shinjuku.lg.jp/foreign/english/aramashi/gaiyou/gaiyou.html.

Shinjuku is a many-sided town, with a busy shopping area at the east exit, rows of high-rise office buildings with the Tokyo Metropolitan Government Building, the administration center for the government of Tokyo at the west exit, a quiet residential area in Ochiai and a stone-paved street with traces of history in Kagurazaka. It shows the character of Tokyo in the most extreme way and which is why this research focuses on Shinjuku.

Climate Analysis of Shinjuku

Shinjuku lies in a humid subtropical climate zone, with hot humid summers and fairly cold winters with cool spells.[164] The region, like much of Japan, experiences a one-month seasonal lag, according to the data from Japan Meteorological Agency, with the warmest month being August and the coolest month being January (Table 16). It has a wetter summer and a drier winter.[165] Snowfall is sporadic but does occur almost annually.

Table 16 Climate Data of Tokyo

Climate data of Tokyo (wards area, 1971-2000)													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	9.8 (49.6)	10.0 (50)	12.9 (55.2)	18.4 (65.1	22.7 (72.9)	25.2 (77.4)	29.0 (84.2)	30.8 (87.4)	26.8 (80.2)	21.6 (70.9)	16.7 (62.1)	12.3 (54.1)	19.7 (67.5)
Daily mean °C (°F)	5.8 (42.4	6.1 (43)	8.9 (48)	14.4 (57.	18.7 (65.7	21.8 (71.2	25.4 (77.7	27.1 (80.8	23.5 (74.3	18.2 (64.8	13.0 (55.4	8.4 (47.1	15.9 (60.6)
Average low °C (°F)	2.1 (35.8)	2.4 (36.3	5.1 (41.2)	10.5 (50.9	15.1 (59.2)	18.9 (66)	22.5 (72.5)	24.2 (75.6)	20.7 (69.3)	15.0 (59)	9.5 (49.1)	4.6 (40.3)	12.5 (54.5)
Precipitation m m (inches)	48.6 (1.91	60.2 (2.37	114.5 (4.508	130 (5.13	128.0 (5.039	164.9 (6.492	161.5 (6.358	155.1 (6.106	208.5 (8.209	163.1 (6.421	92.5 (3.642)	39.6 (1.559	1,466. (57.74
% Humidity	50	51	57	62	66	73	75	72	72	66	60	53	63.1
Precipitation days	4.6	5.8	9.5	10.1	9.6	11.9	10.4	8.2	11.3	9.1	6.2	3.8	100.5
Avg. snowy days	2.7	3.5	2.2	0	0	0	0	0	0	0	0	0.7	9.1
Sunshine hours	180.5	161.1	159.2	164.9	180.9	120.1	147.5	177.5	112.9	129.9	141.4	171.1	1,847.2

Source: Japan Meteorological Agency and Hong Kong Observatory.

164. M. C. Peel, Finlayson, B. L., and McMahon, "Updated World Map of the Köppen-Geiger Climate Classification," (S.l.: Hydrology and Earth System Sciences, 2007).

165. Japan Meteorological Agency, "Average (Annual and Monthly Figures)," Ministry of Land, Infrastructure, Transport and Tourism, http://www.jma.go.jp/jma/menu/report.html.

From the data provided by Japan Meteorological Agency, I organized and created a weather file of the site. By analyzing this file using Autodesk Ecotect Weather Tool 2011, the microclimate data of the project site has been successfully converted in easily readable graphs.

Figure 130 and Figure 131 are showing the average wind speed and directions. As shown on the graphs, there are moderate winds with no definite directions, except that stronger wind tends to blow from north. Many delicate plants, such as strawberries and pumpkins, must be protected by the wind. Hence this analysis indicates the necessity of wind protection when placing the agricultural field facing north.

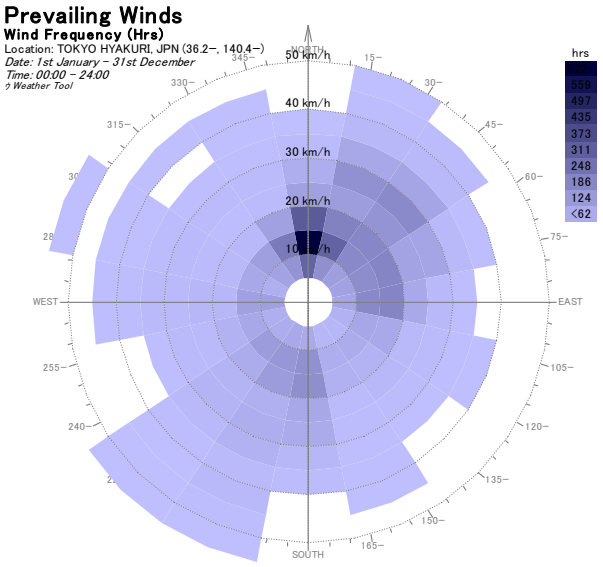


Figure 130 Prevailing Winds (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

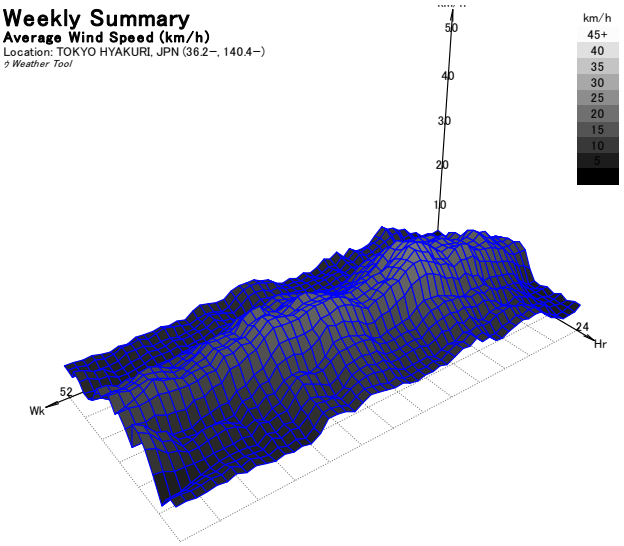


Figure 131 Weekly Summary of Average Wind Speed (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

The average cloud coverage is shown on Figure 132 in a three-dimensional graph. Each axis is indicating the following factors; X-axis (towards left bottom) is week, Y-axis (towards right bottom) is hours and Z-axis (towards top) is the coverage of cloud. It also describes the rainy season along with Figure 133. Typically, more precipitation is observed in summer and winter tends to be dry. Also, typhoon season is around September according to Cabinet Office, Government of Japan.

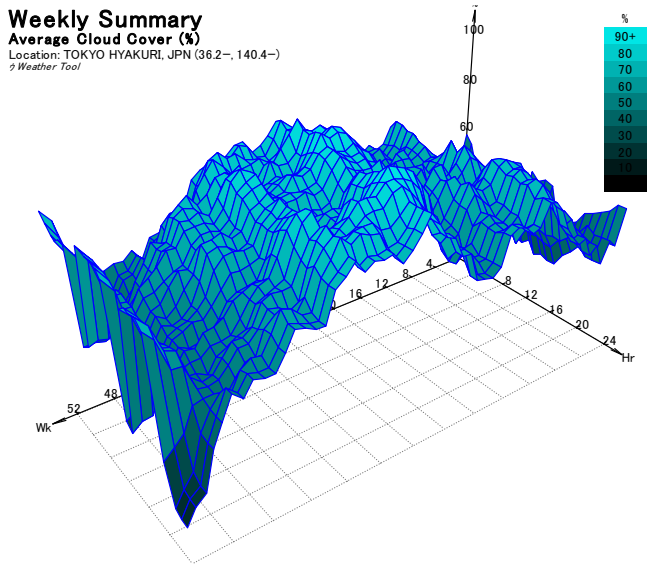


Figure 132 Weekly Summary of Average Cloud Cover (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

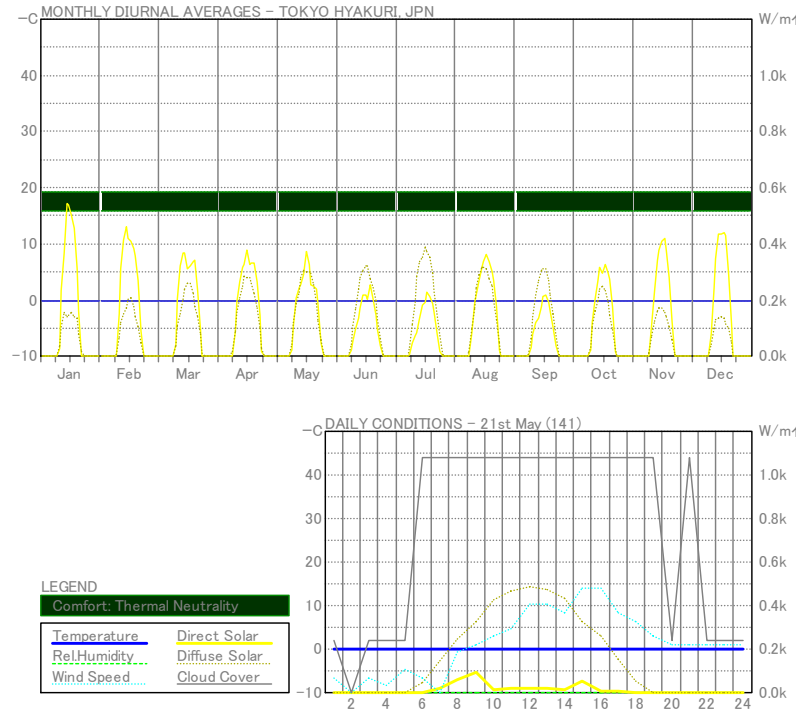


Figure 133 Monthly Diurnal Average (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

Direct solar radiation is very high in summer and diffused solar radiation is relatively high in winter (Figure 135 and Figure 134). By combining these data with the precipitation rate, I plotted them into psychrometric chart (Figure 136). It shows that Tokyo is hot and humid in summer and cold and dry in winter; however, the established comfort zone is shown in between and far from two climates. It is very challenging to design the comfort spaces without relying on active solar system in these climates. However, natural plants could aid significantly. For instance, the broad-leaved plants spout in spring and broaden their leaves in summer. These leaves can block the direct sunlight from reaching buildings. In the fall season, flowers bloom, and the entire leaves die down in winter so that direct sunlight penetrates through the plants and warm up the buildings. This strategy has been used for a long time typically with trees, and many research have been conducted (Chapter 3.1.1), but agricultural plants could gain the same effects placed on the rooftop or walls.

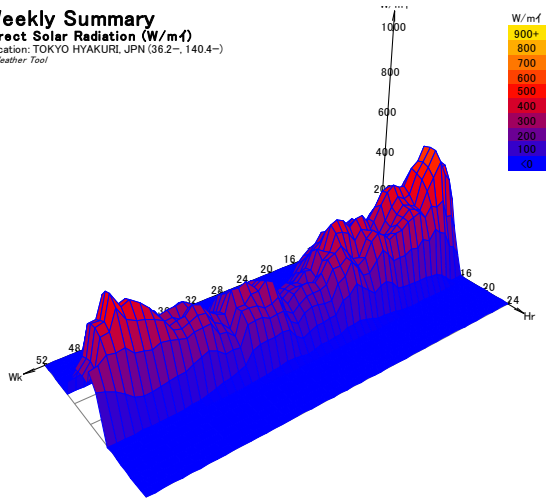


Figure 135 Weekly Summary of Direct Solar Radiation (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

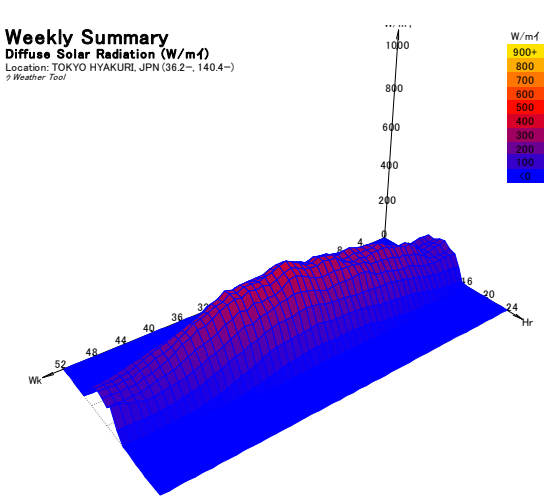


Figure 134 Weekly Summary of Diffuse Solar Radiation (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

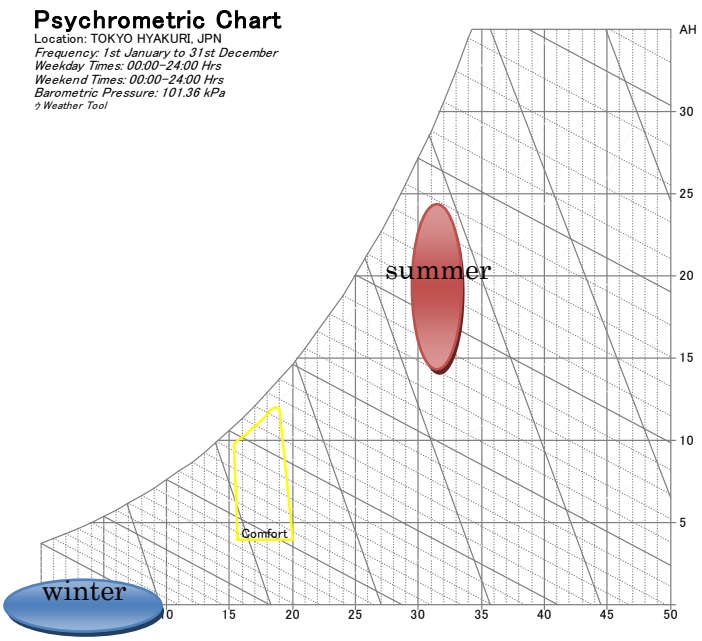


Figure 136 Psychrometric Chart (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

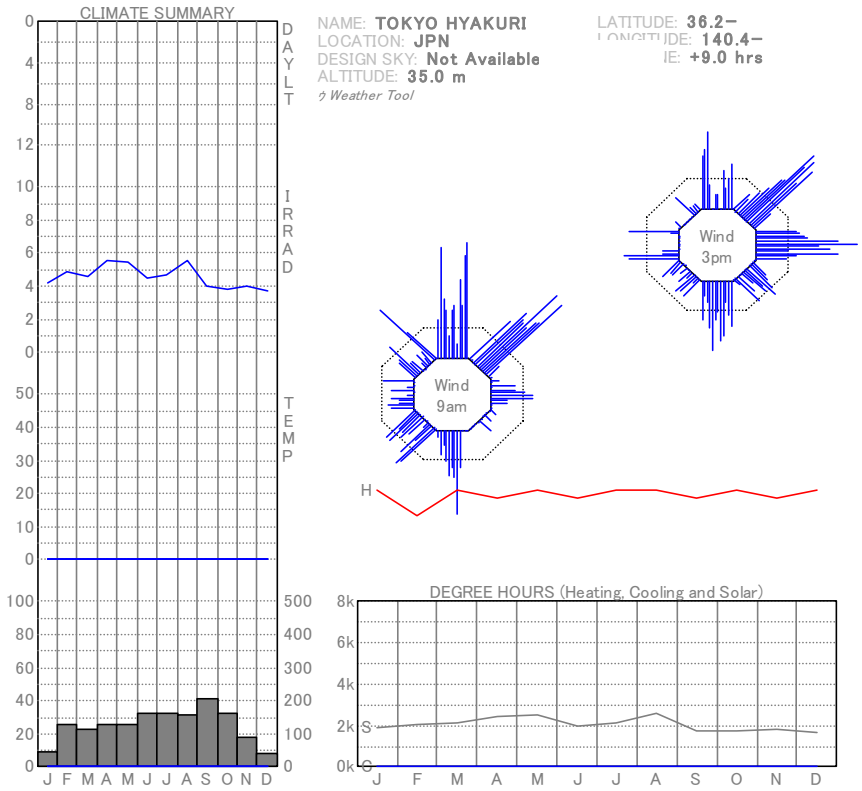


Figure 137 "Monthly Climate Summary" (Image prepared by Takao Ugai, exported from Autodesk Ecotect Weather Tool 2011, data based on Japan Meteorological Agency)

Land Use Analysis of Shinjuku

The project site is located at the western part of Shinjuku. The address is 2~4 Nishi Shinjuku, Tokyo, Japan, and coordinates are 35° 41′ 23.7″ N 139° 42′ 1.3″ E. The total area of the site is 496,180.1 m² (5,340,839 ft²), length of the perimeter is 2,980 m (9,777 ft), and the population is approximately 8,700 people. It includes a high-rise business building, the Tokyo Metropolitan Government Building, Shinjuku Central Park, city hotels, 6 schools, hospitals, a postal office, restaurants, supermarkets, high-rise and low-rise housing and mix-use buildings. This area shows all of the aspects of typical urban situation in Tokyo.

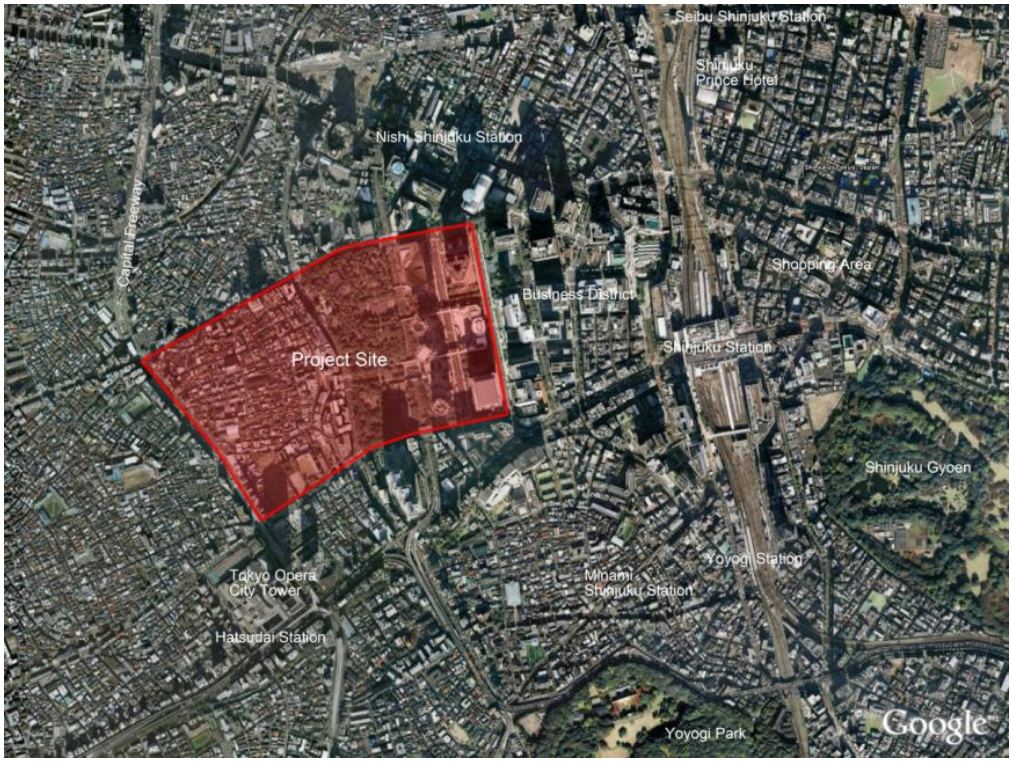


Figure 138 Map of Shinjuku (Diagram prepared by Takao Ugai, based on map exported from Google Earth Pro, Google Inc.)

Figure 139 Map of Project Site (Diagram prepared by Takao Ugai, based on map exported from Google Earth Pro, Google Inc.)

The analysis of various methodologies of urban agriculture practices can be done by modeling each of the buildings on the project site and color coordinating those by use of the building.

Table 17 Color coordination of use of the building

Color Coordination				
Civic	Commercial	Community	Convenient Store	Supermarket
Hospital	Hotel	Open Space	Post Office	
High-rise Residence	Low-rise Residence	Restaurant	School	

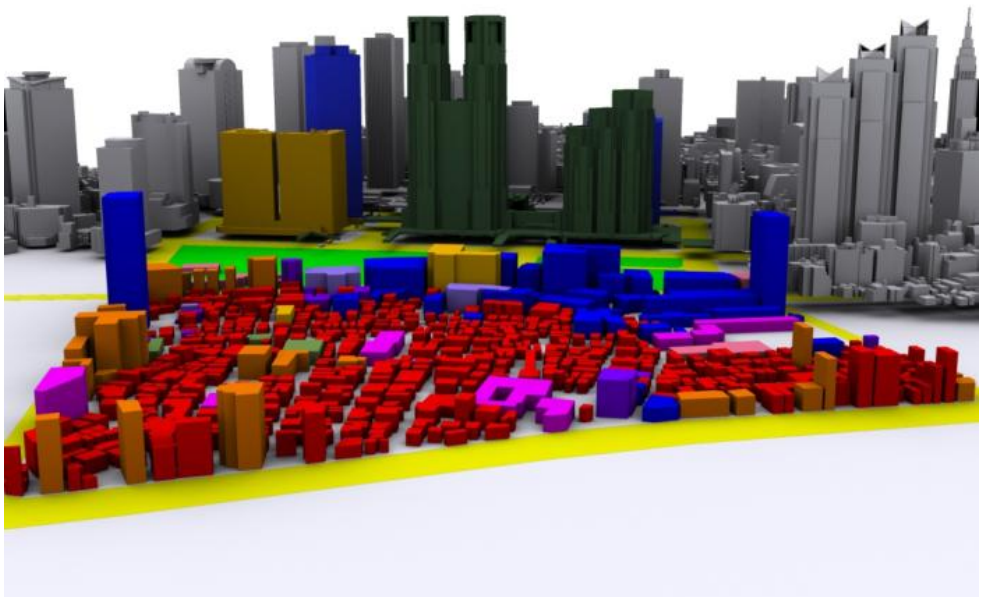


Figure 140 3D Building Use Analysis 1 (Rendering prepared by Takao Ugai)

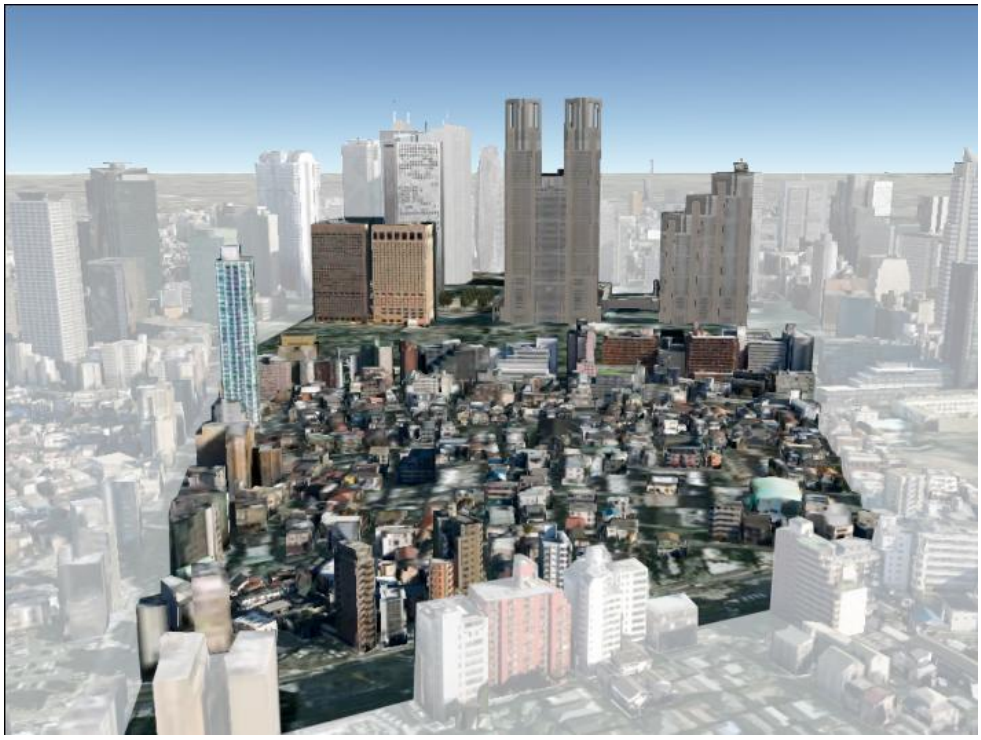


Figure 141 3D Arial Image 1 (Rendering prepared by Takao Ugai based on map exported from Google Map, Google Inc.)

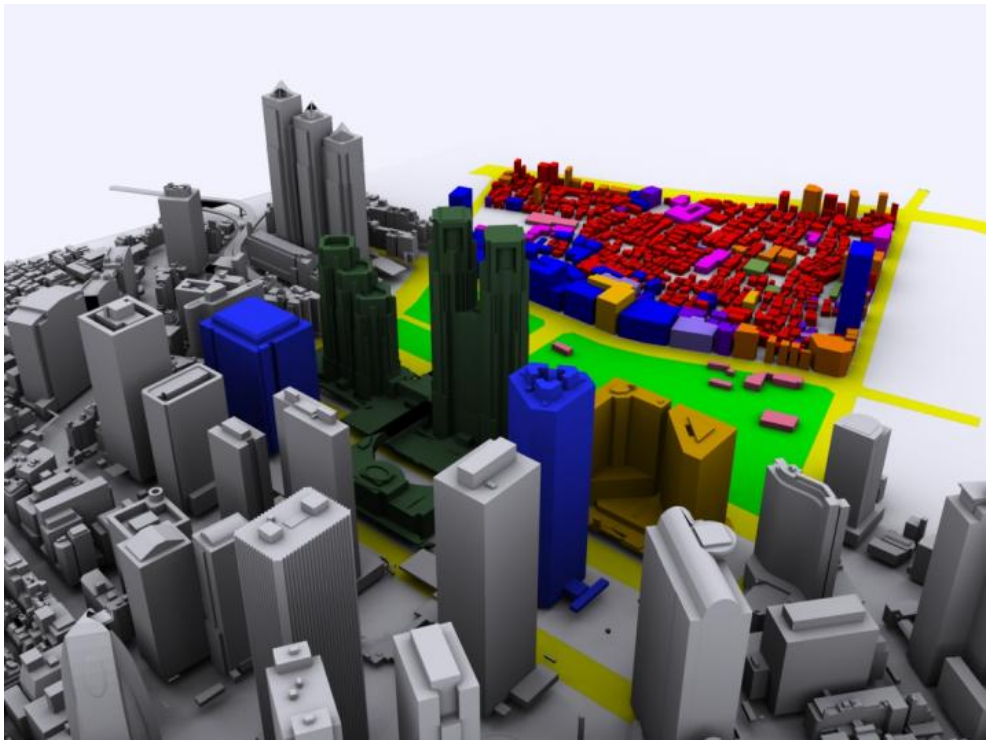


Figure 142 3D Building Use Analysis 2 (Rendering prepared by Takao Ugai)

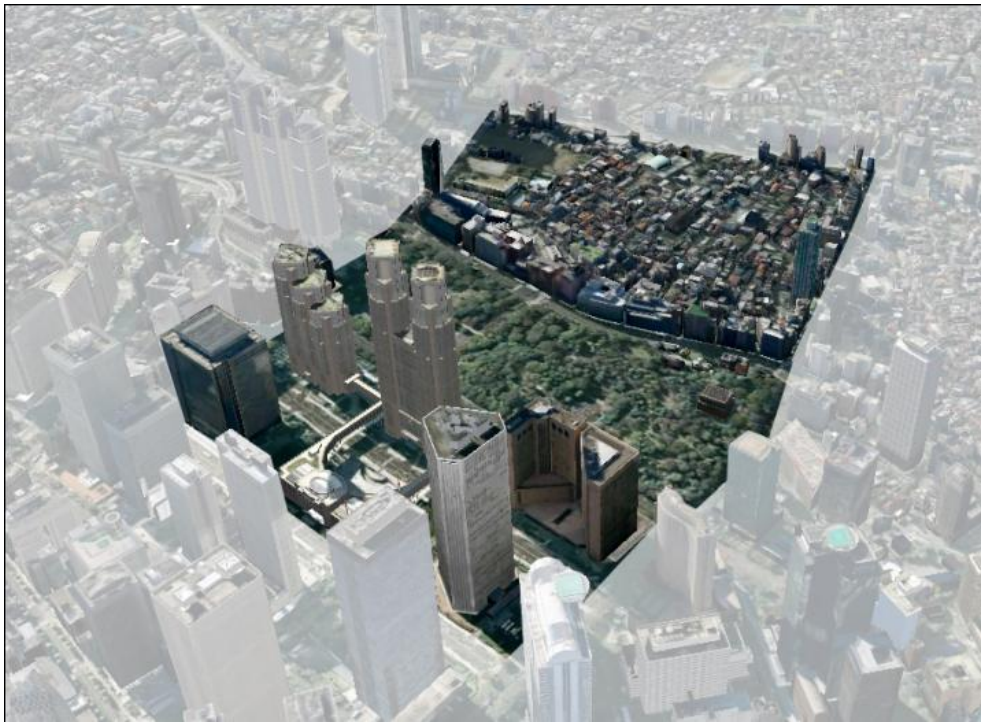


Figure 143 3D Arial Image 1 (Rendering prepared by Takao Ugai based on map exported from Google Map, Google Inc.)

Appendix B: Plant List

This appendix offers the list of plants that this research focuses on. Selection of plants based on the suitability of local climates and demands of local people's dietary habits in Tokyo, Japan. There are many other plants that are not covered in this list, but it could be easily done by filling the chart and utilizing the list of resources below. Each listed plant describes the best sitting conditions, sowing, transplanting, harvesting seasons. It also discusses some of the companions and adverse effect plants. Companion plants can benefit each other in a number of different ways, including: hedged investment, nitrogen fixation, increased level interaction, flavor enhancement, pest suppression, pollinator and predator recruitment, protective shelter, positive hosting, trap cropping and pattern disruption.[166] The color of the flowers and leaves and size of the plants are also important in the selecting process. In the urban agriculture, the plants are not only a source of food but functions as part of the landscape and architectural design elements. This basic information will help architects to decide which plants are more suitable to the situations.

Resources:

Fine Gardening Article: http://www.finegardening.com/
Food from the garden:
http://www.food-from-the-garden.com/food-garden-index.html
Gardenality: http://www.gardenality.com/
Gardening ideas, tips and advice: http://gardening.about.com
Golden Harvest Organics: http://www.ghorganics.com/
Hawaii Homegrown Food Network: http://hawaiihomegrown.net/
University of Florida EDIS: http://edis.ifas.ufl.edu/topics/agriculture/crops.html
University of Hawaii at Manoa CTAHR: http://www.ctahr.hawaii.edu/site/
University of Missouri Extension: http://extension.missouri.edu/

166.S. & Collier Finch, R. H., "Insects Can See Clearly Now the Weeds Have Gone," *Research International, Wellesbourne* Biologist, 50 (3)(2003): 132-35.

Asparagus: It is recommended to sit in the sun, sow from late March to early April, transplant from late March to early April and harvest from mid April to mid June. It is good company for aster family flowers, dill, coriander, carrots, tomatoes, parsley, basil, comfrey and marigolds but keep away from onions, garlic and potatoes.

Figure 144 Asparagus

Green Beans: It is recommended to sit in the sun, sow from late May to early June and harvest from August to October. All beans enrich the soil with nitrogen fixed form the air, improving the conditions for whatever crop you plants after the beans are finished. In general they are good company for carrots, celery, chards, corn, eggplant, peas, potatoes, brassicas, beets, radish, strawberry and cucumbers. Beans are great for heavy nitrogen users like corn and grain plants because the nitrogen used up by the corn and grains are replaced at the end of the season when the bean plants die back. French Haricot beans, sweet corn and melons are a good combo. Summer savory deters bean beetles and improves growth and flavor. It is better to keep away from the alliums.

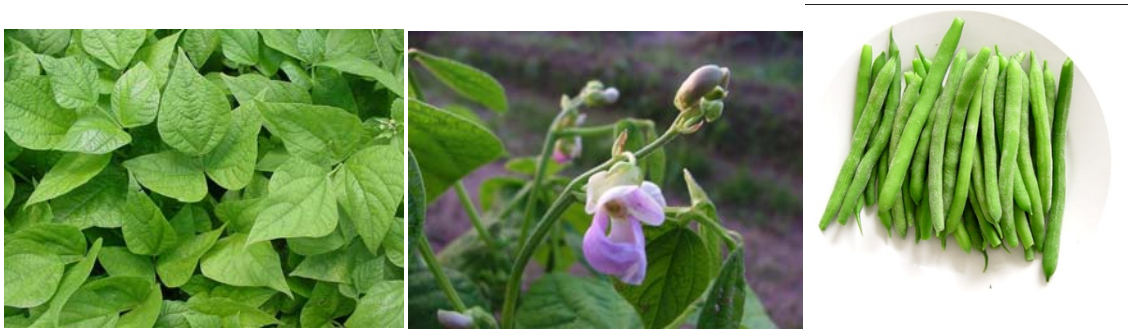


Figure 145 Green beans

Beetroot: It is recommended to sit in the sun/semi shade, sow from March to June and harvest from July to October. It is good for adding minerals to the soil. The leaves are composed of 25% magnesium making them a valuable addition to the compost pile if you don't care to eat them. Beetroots are also beneficial to beans with the exception of runner beans. Runner or pole beans and beets stunt each other's growth. Companions for beets are lettuce, onions and brassicas. Beets and kohlrabi grow perfectly together. Beets are helped by garlic and mints. Garlic improves growth and flavor. Rather than planting invasive mints around beets use your mint clippings as mulch.

Figure 146 Beetroot

Broccoli: It is recommended to sit in the sun/semi shade, sow from April to May, transplant from June to July and harvest in autumn (green) or late winter/spring (purple). Companions for broccoli are: basil, bush beans, cucumber, dill, garlic, hyssop, lettuce, marigold, mint, nasturtium, onion, potato, radish, rosemary, sage, thyme and tomato. Celery, onions and potatoes improve broccolis' flavor when planted near it. Pairing it with plants that need little calcium is a good combination such as nasturtiums and beets. Herbs such as rosemary, dill and sage help repel pests with their distinct aromas. Foes: Grapes, strawberries, mustards and rue.

Figure 147 Broccoli

Cabbage: It is recommended to site in the sun and sow/transplant/harvest season depends on variety. Good for loosening compacted soil with its deep roots so it is also compatible next to shallow rooted crops. Plant it with strawberries, but keep it away from dill and fennel. The flowers attract a number of beneficial insects especially the tiny parasitic wasps.

Figure 148 Cabbage

Carrots: It is recommended to site in the sun, sow from April to June and harvest from July to October. Companions are leaf lettuce, onions and tomatoes, but keep away from dill and parsnips. Flax produces oil that may protect root vegetables like carrots from some pests. Tomato plants can stunt the growth of your carrots but the carrots will still be of good flavor.

Figure 149 Carrots

Cucumber: It is recommended to site in the sun, sow in mid March, transplant in April and harvest from June to July. Cucumbers are great to plant with corn and beans. Three plants like the same conditions: warmth, rich soil and plenty of moisture. Let the cucumbers grow up and over your corn plants. Companions for cucumbers are peas, beets, radishes and carrots. Radishes are a good deterrent against cucumber beetles. Dill planted with cucumbers helps by attracting beneficial predators. Nasturtium improves growth and flavor. Keep sage, potatoes, tomatoes and rue away from cucumbers.

Figure 150 Cucumber

Garlic: It is recommended to site in the sun, sow from October to over winter and harvest in mid August. It is good company with roses, apple trees, pear trees, cucumbers, peas, lettuce and celery. Garlic accumulates sulfur: a naturally occurring fungicide which will help in the garden with disease prevention. Garlic is systemic in action as it is taken up by the plants through their pores and when garlic tea is used as a soil drench it is also taken up by the plant roots. It has value in offending codling moths, Japanese beetles, root maggots, snails, and carrot root fly.

Figure 151 Garlic

Lettuce: It is recommended to site in the semi shade, sow from July to February, transplant in April and harvest from mid June to mid October. It is good company with beets, broccoli, bush beans, pole beans, carrots, cucumbers, onion, radish and strawberries, but keep away from cabbage. Cabbage is a deterrent to the growth and flavor of lettuce.

Figure 152 Lettuce

Onions: It is recommended to site in the sun, sow from February to March and harvest from July to September. Planting chamomile and summer savory with onions improves their flavor. Other companions are carrot, leek, beets, kohlrabi, strawberries, brassicas, dill, lettuce and tomatoes. Onions planted with strawberries help the berries fight disease. It is better to keep away from peas and asparagus.

Figure 153 Onion

Potatoes: It is recommended to site in the sun, sow from late March to April and harvest from June to October. Companions for potatoes are bush bean, members of the cabbage family, carrot, celery, corn, dead nettle, flax, horseradish, marigold, peas, petunia, onion and Tagetes marigold, but keep away from asparagus, cucumber, kohlrabi, parsnip, pumpkin, rutabaga, squash family, sunflower, turnip, tomato and fennel. Horseradish, planted at the corners of the potato patch, provides general protection.

Figure 154 Potato

Tomatoes: It is recommended to site in the sun, sow in early April, transplant in late May to early June and harvest in August to September. Tomato allies are many: asparagus, basil, bean, carrots, celery, chive, cucumber, garlic, head lettuce, marigold, mint, nasturtium, onion, parsley, pea, pepper, marigold, pot marigold and sow thistle. Basil repels flies and mosquitoes, improves growth and flavor. Bee balm, chives and mint improve health and flavor. Borage deters tomato worm, improves growth and flavor. Dill, until mature, improves growth and health, mature dill retards tomato growth. Keep tomatoes away from corn, tomato, potatoes, apricot, dill, fennel, cabbage and cauliflower.

Figure 155 Tomato

Wheat: It is recommended to site in the sun, sow from April to May and harvest from mid August to mid September. There are no companions for wheat, but it is incompatible with barberry and lettuce. It will not grow in hydroponic or aeroponic.

Figure 156 Wheat

Bibliography

Adams, John E. "Influence of Mulches on Runoff, Erosion and Soil Moisture Depletion." *America Society of Soil Science Proceedings* 30 (1966): 110-14.

Aelion, C. M., J. N. Shaw, and M. Wahl. "Impact of Suburbanization on Ground Water Quality and Denitrification in Coastal Aquifer Sediments." *Journal of Experimental Marine Biology and Ecology* 213 (1997): 31-51.

Agency, Japan Meteorological. "Average (Annual and Monthly Figures)." Ministry of Land, Infrastructure, Transport and Tourism, http://www.jma.go.jp/jma/menu/report.html.

"Agricultural Department." List of Universities in Japan, http://university.info-list.net/department/agriculture.html.

Agriculture, United States Department of. "Production, Supply and Distribution Database." United States Department of Agriculture, 2008.

——. "Production, Supply and Distribution Database." United States Department of Agriculture, 2011.

Akagawa, H. "Photovoltaic Capacity of Greater Sydney Roof Scapes.": University of Sydney and Obayashi Technical Research Institute, 2002.

Akbari, H. "Shade Trees Reduce Building Energy Use and Co2 Emissions from Power Plants." *Environ Pollut* 116 Suppl 1 (2002): S119-26.

Akbari, H., L. Gartland, and S. Konopacki. "Measured Energy Savings of Lightcolored Roofs: Results from Three California Demonstration Sites." *Proceedings of the 1998 ACEEE Summer Study on Energy Efficiency in Buildings* (1998).

Akbari, H., A. H. Rosenfeld, and H. Taha. "Summer Heat Islands, Urban Trees, and White Surfaces." *ASHRAE Proceedings* (1990).

al, Jim Hollyer et. "On-Farm Food Safety: Aquaponics." Honolulu, Hawaii: College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, 2009.

"Aquaponic Technology, Systems and Supplies." 18 Nelson and Pade Inc., https://aquaponics.com/.

Asiajin. "Sunshine Ranch: More Than 2m Japanese Users Join China-Made Flash Game in 2 Months." Asiajin - the next generation interenet trends in Japan and Asia, http://asiajin.com/blog/2009/10/26/sunshine-ranch-more-than-2m-japanese-users-join-china-made-flash-game-in-2-months/.

"The Bachelor Farmer." The Bachelor Farmer, http://thebachelorfarmer.com/.

Ballantyne, E. R., R. K. Hill, and J. W. Spencer. "Probit Analysis of Thermal Sensation Assessments." *Int J Biometeorol* 21, no. 1 (1977): 29-43.

Bealey, W. J., A. G. McDonald, E. Nemitz, R. Donovan, U. Dragosits, T. R. Duffy, and D. Fowler. "Estimating the Reduction of Urban Pm10 Concentrations by Trees within an Environmental Information System for Planners." *J Environ Manage* 85, no. 1 (2007): 44-58.

Beaulieu, Patra. "Sky Planter Upside-Down Plant Pot." GeekAlerts, http://www.geekalerts.com/sky-planter-upside-down-plant-pot/.

"Bell Book & Candle." Bell Book and Candle, http://bbandcnyc.com/.

Bernatzky, A. "The Contribution of Trees and Green Spaces to a Town Climate." *Energy and Buildings*, no. 5 (1982): 1-10.

Berndtsson, J. C., T. Emilsson, and L. Bengtsson. "The Influence of Extensive Vegetated Roofs on Runoff Water Quality." *Sci Total Environ* 355, no. 1-3 (2006): 48-63.

Berry, R. D., and J. J. Colls. "Atmospheric Carbon Dioxide and Sulphur Dioxide on an Urban/Rural Transect-1. Continuous Measurements at the Transect Ends." *Atmospheric Environment* 24A (1990): 2681-88.

Bruegmann, Robert. *Sprawl : A Compact History*. Chicago: University of Chicago Press, 2005.

Buchanan, Kevin. "Agricultural Urbanism –Integrating Farming with the Built Environment." http://fortworthology.com/2008/07/15/agricultural-urbanism-integrating-farming-with-the-built-environment/.

Building, Mori. "The Ark Hills Times." ARK Hills, http://www.arkhills.com/.

Bullen, R., and F. Fricke. "Sound Propagation through Vegetation." *Journal of Sound and Vibration*, no. 80 (1982): 11-23.

Bureau, Population Reference. "World Population Data Sheet." Population Reference Bureau, 2008.

Cairns, J. "Sustainability and the Future of Humankind: Two Competing Theories of Infinite Substitutability." *Politics and the Life Sciences*, no. 1 (2000): 27-32.

Calvert, Catherine. "Transit + Food = Sustainability in Philadelphia." VIA Architecture, http://via-architecture.blogspot.com/2012/09/transit-food-sustainability-in.html.

Canin, L. H. "Psychological Restoration among Aids Caregivers: Maintaining Self-Care.", University of Michigan, 1991.

Caprara, Gian V., and Paolo Renzi. "The Frustration-Aggression Hypothesis Vs. Irritability." *Recherches de Psychologie Sociale*, no. 3 (1981).

centre, WHO Media. "Obesity and Overweight." World Health Organization, 2011.

Chih, F. F., and L. L. Der. "Guidance for Noise Reduction Provided by Tree Belts." *Landscape and Urban Planning*, no. 71 (2005): 29-34.

"China's Social Gaming Landscape: What's Coming Next." ReadWriteWeb, http://www.readwriteweb.com/archives/china_social_gaming_landscape_whats_coming_next.php.

Coleman, M. D., R. E. Dickson, J. G. Isebrands, and D. F. Karnosky. "Carbon Allocation and Partitioning in Aspen Clones Varying in Sensitivity to Tropospheric Ozone." *Tree Physiol* 15, no. 9 (1995): 593-604.

Congress for the New Urbanism, Natural, and the U.S. Green Building Council Resources Defense Council. *Leed 2009 for Neighborhood Development*. Washington, DC: U.S. Green Building Council, Inc., 2010.

Conklin, Everett. "Interior Plants Bring Nature Indoors." 139(2):12-13 (1974).

——. "Interiorlandscaping. 1." *Arboriculture 4* (1978).

Coppin, N. J., I. G. Richards, and Construction Industry Research and Information Association. *Use of Vegetation in Civil Engineering*. London ; Boston: Butterworths, 1990.

Corporation, Japan Finance. "Consumer Trend Survey." Japan Finance Corporation, 2010.

Croxford, B., A Penn, and B Hillier. "Spatial Distribution of Urban Pollution: Civilizing Urban Traffic." *Science of the Total Environment* 190 (1996): 3-9.

Despommier, Dickson D. *The Vertical Farm : Feeding the World in the 21st Century*. 1st ed. New York: Thomas Dunne Books/St. Martin's Press, 2010.

Diestel, H., M. Kohler, and M. Schmidt. "Funktion Begrunter Dacher Im Stadtischen Raum." *Bundesbaublatt* 9 (1993): 729-34.

Douglas, and James S. "Hydroponics." *Bombay, No. 5th Ed.* (1975).

Droege, Peter. *100% Renewable : Energy Autonomy in Action*. London ; Sterling, VA: Earthscan, 2009.

——. *The Renewable City : A Comprehensive Guide to an Urban Revolution*. Chichester, England ; Hoboken, NJ: Wiley-Academy, 2006.

Dwyer, J. F., Schroeder, H. W. and Gobster, P. H. *The Deep Significance of Urban Trees and Forests*, The Ecological City: Preserving and Restoring Urban Biodiversity. Massachusetts: University of Massachusetts Press, 1994.

E.O., Moore. "A Prison Environment's Effect on Health Care Service Demands." *J. Environmental Systems II* (1981).

Emmanuel, R. "Thermal Comfort Implications of Urbanization in a Warmhumid City: The Colombo Metropolitan Region (Cmu)." *Building and Environment*, no. 40 (2005): 1591-601.

Finance, Ministry of. "Trade Statistics of Japan." Ministry of Finance Japan, 2010.

Finch, S. & Collier, R. H. "Insects Can See Clearly Now the Weeds Have Gone." *Research International, Wellesbourne* Biologist, 50 (3) (2003): 132-35.

Finnegan, Mary C., and Linda Zener Solomon. "Work Attitudes in Windowed Vs. Windowless Environments." *The Journal of Social Psychology* 115, no. 2 (1981): 291.

Fricke, F. "Sound Attenuation in Forest." *Journal of Sound and Vibration*, no. 92 (1984): 149-58.

Frumkin, Howard, Lawrence D. Frank, and Richard Jackson. *Urban Sprawl and Public Health : Designing, Planning, and Building for Healthy Communities*. Washington, DC: Island Press, 2004.

Fuhrer, Jürg. "Agroecosystem Responses to Combinations of Elevated Co2, Ozone, and Global Climate Change." In *Agriculture, Ecosystems & Environment*, 20: Elsevier Science B.V., 2002.

Furedy, Christine, and Tasneem Chowdhury. "Solid Waste Reuse and Urban Agriculture--Dilemmas in Developing Countries: The Bad News and the Good News." Ryerson Polytechnic University, 1996.

"Genetic Diversity and Disease Control in Rice." *Nature 406*.

Gittleman, Mara, Lenny Librizzi, and Edie Stone. "Community Garden Survey New York City." GrowNYC, 2010.

Givoni, B. "Impact of Planted Areas on Urban Environmental Quality: A Review." *Atmospheric Environment* 25B(3) (1991): 289-99.

"Greenhouse Gases, Climate Change, and Energy." *Energy Information Administration* (May, 2008).

Gregory, McPherson E. "Green Roofs: Not Your Garden-Variety Amenity." *Facilities Design & management*, no. 16 (10) (1994): 32.

Hamm, Michael, and Monique Baron. *Developing an Integrated Sustainable Urban Food System: The Case of New Jersey, United States*, For Hunger- Proof Cities: Sustainable Urban Food Systems. Ottawa: International Development Research Centre, 1999.

Heisler, G. M. "Energy Savings with Trees." *Journal of Arboriculture* 12(5) (1986): 113-25.

Hendriks, Nico A. "Designing Green Roof Systems: A Growing Interest." *Professional Roofing*, September, 1994, 20-21.

Ho, Victoria. "China Wants Multiplayer, Micropayments." ZDNET, http://www.zdnetasia.com/china-wants-multiplayer-micropayments-62061926.htm.

Hosetti, B.B. "Urban Agriculture and Solid Waste Management." In *Prospects and Perspectives of Solid Waste Management*. New Delhi: New Age International Publishers, 2006.

Hoyano, Akira. "Climatological Uses of Plants for Solar Control and the Effects on the Thermal Environment of a Building." *Energy and Buildings* 11, no. 1–3 (1988): 181-99.

"Hyatt Regency Tokyo." Hyatt Corporation, http://tokyo.regency.hyatt.com/hyatt/hotels-tokyo-regency/entertainment/dining_detail.jsp?itemDesc=fboutlet&itemId=1000027.

Imanishi, Kinji, and Pamela J. Asquith. *A Japanese View of Nature : The World of Living Things*, Japan Anthropology Workshop Series. London ; New York, NY: RoutledgeCurzon, 2002.

Ito, Kenzo, and John Dyck. "Fruit Policies in Japan." edited by United States Department of Agriculture, 2010.

Jensen, Merle H. "Hydroponics Worldwide - a Technical Overview." Tucson, Arizona: University of Arizona, 2002.

Johnston, J., and J. Newton. "Building Green: A Guide for Using Plants on Roofs, Walls and Pavements." *The London Ecology Unit* (1996).

——. "Building Green: A Guide for Using Plants on Roofs, Walls and Pavements." *The London Ecology Unit* (1996).

——. *Building Green: A Guide for Using Plants on Roofs, Walls and Pavements.* London: The London Ecology Unit, 1996.

Kelbaugh, Doug. *Repairing the American Metropolis*. Seattle: University of Washington Press, 2002.

Kidd, Aline H., and Robert M. Kidd. "Benefits, Problems, and Characteristics of Home Aquarium Owners." *Psychological Reports* Volume 84, no. Center for Animals in Society, School of Veterinary Medicine, University of California-Davis: 998-1004.

Kohler, M., M. Schmidt, F. W. Grimme, M. Laar, and F. Gusmao. "Urban Water Retention by Greened Roofs in Temperate and Tropical Climates." In *Conference of the 38th IFLA World Congress*. Singapore, 2001.

Kuo, Frances, and William Sullivan. "Environment and Crime in the Inner City - Does Vegetation Reduce Crime?" *Environment and Behavior* Vol. 33, no. 3 (2001): 343-67.

Le, Corbusier. *The Radiant City; Elements of a Doctrine of Urbanism to Be Used as the Basis of Our Machine-Age Civilization*. New York,: Orion Press, 1967.

Leccese, Michael, Kathleen McCormick, and Congress for the New Urbanism. *Charter of the New Urbanism*. New York: McGraw Hill, 2000.

Lewis, Charles A. *Green Nature/Human Nature : The Meaning of Plants in Our Lives*, The Environment and the Human Condition. Urbana: University of Illinois Press, 1996.

Louv, Richard. *Last Child in the Woods : Saving Our Children from Nature-Deficit Disorder*. 1st ed. Chapel Hill, NC: Algonquin Books of Chapel Hill, 2005.

M.K., Honeyman. *The Role of Horticulture in Human Well-Being and Social Development: A National Symposium*. Portlan, OR: Timber Press, 1992.

Malone, Robert. "World's Worst Waste." http://www.forbes.com/2006/05/23/waste-worlds-worst-cx_rm_0524waste.html.

Manson, R. H., Laviana I.E., and EH. Rohles. *Plants as Enhancers of the Indoor Environment*. Santa Monica1983.

Marchant, B. "A Look at the Industry-Dimensions and Prospects." *Amer. Nurseryman* 156(10) (1982).

Martinez-Sara, R., C. Rubio, L. M. Garcia-Raffi, J. V. Sanchez-Perez, E. A. Sanchez-Perez, and J. Llinares. "Control of Noise by Trees Arranged Like Sonic Crystals." *Journal of Sound and Vibration*, no. 291 (2006): 100-06.

McpPherson, E. G., D. J. Nowak, G. Heisler, S. Grimmond, C. Souch, and R. Grant. "Quantifying Urban Forest Structure, Function, and Value: The Chicago Urbanforest Climate Project." *Urban Ecosystems* 1 (1997): 49-61.

Mehaffy, Michael. "The Landscape Urbanism: Sprawl in a Pretty Green Dress?" Planetizen: Urban Planning, Design and Development Network, http://www.planetizen.com/node/46262.

Michael, S.N., R.B. Hull, and D.L. Zahm. "Environmental Factors Influencing Auto Burglary: A Case Study." (1999).

Miltner, R. J., D. White, and C. Yoder. "The Biotic Integrity of Streams in Urban and Suburbanizing Landscapes." *Landscape and Urban Planning* 69 (2004): 87-100.

Ministry of Economy, Trade and Industry. "Cost of Solid Waste Treatment." http://www.meti.go.jp/.

Minke, G., and G. Witter. "Haeuser Mit Gruenem Pelz, Ein Handbuch Zur Hausbegruenung." In *Verlag Dieter Fricke GmbH*. Frankfurt, 1982.

Moodie, Maureen. "The Mid-Atlantic Red Fruit Festival." In *DC's Field to Fork*. Washington D.C.: DC's Field to Fork Network, 2010.

Moore, Robin C., and Herb H. Hong. "Natural Spaces and Materials Stimulate Children's Limitless Imaginations." In *Natural Learning: Creating Environments for Rediscovering Natrue's Way of Teaching*. Berkeley, CA: MIG Communications, 1997.

Murphy, Katie. "Farm Grows Hydroponic Lettuce." *The Observer* (2006).

"National Health and Nutrition Survey." Ministry of Health, Labour and Welfare, 2008.

Nations, Food and Agriculture Organization of the United. "Import and Export Values of Agricultural Products of Major Countries." Food and Agriculture Organization of the United Nations, 2007.

Ng, Elliott. "China's Growing Addiction: Online Farming Games." VentureBeat, http://venturebeat.com/2009/10/29/china-qq-farm-happy-farm-games/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+Venturebeat+%28VentureBeat%29.

OECD. "Agricultural Policies in Oecd Countries." (2010), http://www.oecd.org/dataoecd/37/16/43239979.pdf.

"Oecd Annual Report 2008." Organisation for Economic Co-operation and Development, 2008.

Office, Shinjuku Ward. "Description of Shinjuku." Shinjuku City, http://www.city.shinjuku.lg.jp/foreign/english/aramashi/gaiyou/gaiyou.html.

——. "Population of Shinjuku City." Shinjuku City, http://www.city.shinjuku.lg.jp/kusei/index02_101.html.

Peel, M. C., Finlayson, B. L., and McMahon. "Updated World Map of the Köppen-Geiger Climate Classification." S.l.: Hydrology and Earth System Sciences, 2007.

Porteous, J. Douglas. "Smellscape." *Progress in Human Geography* 9(3) (1985): 356-78.

"Principles of the Environmental Policy in Agriculture, Forestry and Fisheries." edited by Forestry and Fisheries Ministry of Agriculture. Tokyo, Japan, 2011.

Randall, K., P.D. Relf, and E.S. Geller Shoemaker. "Relationships between Plants, Behavior, and Attitudes in an Office Environment." *Hort Technology 2* (1992).

"Reduce, Reuse, Recycle and Recover Waste: A 4r's Guide." edited by Daniel Dickey. Wendake, Quebec: First Nations of Quebec and Labrador Sustainable Development Institute, 2008.

Relf, D. "Psychological and Sociological Response to Plants: Implications Forhorticulture." *Hort Schience 25* (1990).

Rosegrant, Mark W. "Biofuels and Grain Prices: Impacts and Policy Responses." In *Testimony for the U.S. Senate Committee on Homeland Security and Governmental Affair*, 2008.

Rosenfeld, A. H., J. J. Romm, H. Akbari, and A. C. Lloyd. "Painting the Town White and Green." MIT Technology Review, http://eetd.lbl.gov/HeatIsland/PUBS/PAINTING/.

S, Scrivens. *Interior Planting in Large Buildings*. London: The ArchitecturalPress, 1980.

Scholte, R.H.J., M.A.G. van Aken, and C.F.M. van Leishout. "Adolescent Personality Factors in Self-Ratings and Peer Nominations and Their Prediction of Peer Acceptance and Peer Rejection." *Journal of Personality Assessment* 69, no. 534-554 (1997).

School, Ballymaloe Cookery. "About the Ballymaloe Cookery School." Ballymaloe Cookery School, http://www.cookingisfun.ie/pages/about_us/.

Schorr, Steven M., and Richard J. Stoner Jr. "Method and Apparatus for Aeroponic Propagation of Plants." United States: Genisis Technology, Inc., 1985.

Schroeder, Herbert W., and L. M. Anderson. "Perception of Personal Safety in Urban Recreation Sites." *Journal of Leisure Research* 16, no. 2 (1984): 178-94.

Sethi, A.S., D.H.J. Caro, and R.S. Schuler. *Strategic Management Off Technostress in an Information Society*. Lewiston, NY: C.J. Hogrefe. Inc., 1987.

Silva, F. O. T., A. Wehrmann, H. J. Henze, and N. Model. "Ability of Plant-Based Surface Technology to Improve Urban Water Cycle and Mesoclimate." *Urban Forestry and Urban Greening* 4 (2006): 145-58.

Simpson, J.R. "Improved Estimates of Tree-Shading Effects on Residential Energy Use." *Energy and Buildings* 34 (2002): 1067-76.

Smith, Justin. "Farmville." Web Media Brands Inc., http://www.appdata.com/apps/facebook/102452128776-farmville.

Society, National Geographic. "Up on the Roof." *National Geographic* (2011), http://ngm.nationalgeographic.com/2009/05/green-roofs/cook-photography.

Squires, Gregory D. *Urban Sprawl : Causes, Consequences, & Policy Responses*. Washington, D.C.: Urban Institute Press, 2002.

Staff, Greenmuze. "Urban Window Farming." Greenmuze, http://www.greenmuze.com/nurture/urban/2506-urban-window-farming-.html.

Stewart, M. A. "Aggressive Conduct Disorder: A Brief Review." *Aggressive Behavior* 11 (1985).

Sundrom, E. *Work Places: The Psychology of the Physical Environment in Offices and Factories*. New York: Cambridge University Press, 1986.

"Survey on Utilization of Local Produce in School Lunches." Ministry of Education, Culture, Sports, Science and Technology, 2010.

T.F.T., Pluncknett. *Edward I and Criminal Law*. Cambridge, UK1960.

Talbot, Janet Frey, and Rachel Kaplan. "Needs and Fears: The Response to Trees and Nature in the Inner City." *Journal of Arboriculture* 10, no. 8 (1984): 222-28.

Tortorello, Michalel. "Growing Everything but Gardeners." *The New York Times*, October 31 2012.

TourMalaysia. "Malaysia Agriculture Park." impressions.com, http://www.impressions.com.my/agro/masagro/masagro.htm.

Ulrich, R.S., and R. Parsons. "Influences of Passive Experiences with Plants on Individual Well-Being and Helth." In *The Role of Horticulture in Human Well-being and Social Development: A National Symposium*. Arlington, Virginia, Portland: Timber Press Inc., 1992.

Ulrich, Roger. "Natural Versus Urban Scenes: Some Psychophysiological Effects." *Environment and Behavior* 13 (1981): 523-66.

"Uncommon Ground." http://www.uncommonground.com/.

Venolia, Carol, and Debra L. Dadd. *Healing Environments: Your Guide to Indoor Well-Being*: Celestial Arts, 1995.

"Weekday White-Collars Turn Farmers at Weekend." People's Daily Online, http://english.people.com.cn/90001/90782/90872/6711319.html.

Wong, Nyuk Hien. *Tropical Urban Heat Islands : Climate, Buildings and Greenery*, Spon Research. London ; New York: Taylor & Francis, 2009.

"World Health Report." World Health Organization, 2010.

Xinhua. "Japan Likely to Join Tpp Talks Despite Worries on Farm Sector." People's Daily Online, http://english.peopledaily.com.cn/102774/7640934.html.

Yeang, Ken. *Dimensions of Sustainability : Architecture Form, Technology, Environment, Culture* Edited by A. Scott. London: E & FN Spon, 1998.

Zobel, Rechard W., Peter Del Tredici, and John G. Torrey. *Method for Growing Plants Aeroponically 1*. Petersham, Massachusetts: Cabot Foundation, Harvard University, 1975.